Laboratory Safety Officer Guidebook

Joint Safety Team

University of Minnesota
Department of Chemistry and Department of Chemical Engineering & Materials Science

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About this *Guidebook*:

This guidebook was created by members of the Joint Safety Team to:

1. Clarify the roles and responsibilities of an LSO.
2. Serve as a reference and resource for an LSO.
3. Serve as a place to maintain and keep training records for group members.
4. Offer templates for training records, SOPs, and other maintenance records (all templates are available online at http://www.jst.umn.edu).

This guidebook is a working and evolving document. It is a *guidebook*, not a rulebook. It is meant to serve only as a guide and give LSOs the freedom to edit as they see fit for their group. This guide is not intended to address all safety issues, but rather to provide basic information about important components of safety in the chemistry laboratory and to serve as a resource to locate further information. LSOs are encouraged to seek advice from their PI and their group in order to adapt the documents available here to fit their needs. The JST welcomes constructive criticism and strives to continue to update and adapt to the safety needs of LSOs, research groups, and the Departments of Chemistry and Chemical Engineering and Materials Science at the University of Minnesota.

Disclaimer: All documents are to be used only as reference. Researchers must understand they are responsible for their own safety and must seek out additional advice and resources when needed.

The Joint Safety Team (JST)

Mission Statement

Mission

The mission of the JST is to elevate safety awareness and to improve and sustain the safety culture in the Departments of Chemistry (CHEM) and Chemical Engineering & Materials Science (CEMS) at the University of Minnesota. Partnering with Dow Chemical Company for examples, advice, and resources, the JST will work to develop a mindful and integrated safety culture in University of Minnesota laboratories. A variety of methods will be used to achieve an improved culture of safety. The JST currently consists of all Laboratory Safety Officers (LSOs) in CHEM and CEMS, although it may eventually expand to include other departments in the College of Science and Engineering (CSE) and beyond.

Objectives

An improved culture of safety at the University of Minnesota would include:

- Compliance of minimum PPE requirements in all labs
- Improved housekeeping of labs – no clutter, no unknown waste
- Increased communication of safety incidents and accidents
- Fully evaluated, up-to-date, and annually revised laboratory safe operating procedures
- Zero accidents and incidents

Methods

The JST has accomplished the following:

- Created a list of recommendations that would lead to an improved safety culture; all recommendations are in one of four areas: compliance, awareness, resources, education (CARE)
- Began a safety campaign using posters to raise awareness: "Safety Starts with U!"
- Implemented Safety Moments in departmental seminars and group meetings
- Improved and standardized laboratory signage
- Clearly defined laboratory standards
- Clearly defined the roles and responsibilities of a Lab Safety Officer
- Implemented informal lab walkthroughs performed by Lab Safety Officers
- Held first Departmental Cleanup Week
- Created a JST website consisting of resources and links for researchers

Beyond these initial campaigns, the JST plans to:

- Maintain the Safety Campaign
- Implement annual training of Lab Safety Officers
- Hold semiannual Departmental Cleanup Weeks
- Perform semiannual informal lab walkthroughs by Lab Safety Officers
- Maintain the JST website
- Implement an incident and near-miss report database and sharing these results with the community
- Provide safety training workshops on specific topics of interest to researchers
- Implement the use of Safe Operating Cards (SOC)

About CARE: Compliance, Awareness, Resources, Education

- **Compliance:** *Lab Audits* – The JST has organized biannual laboratory audits to help groups stay on top of their housekeeping skills. These internal audits will be conducted by students and used to help labs improve safety conditions for researchers, increase inter-lab awareness of issues and incidents, and to assist in bringing all labs up to compliance with federal and state standards. The ultimate goal is to support the larger JST mission of establishing a sustainable culture of excellent laboratory safety standards that are followed by all researchers on a daily basis.
- **Awareness:** *Lab Signage and Posters* – The JST has created templates that provide information on lab hazards, PPE requirements, and emergency information. All lab safety officers are expected to fill out and post these documents. The JST has also created informational posters, which you will find posted in Kolthoff, Smith, and Amundson.
- **Resources**: *Clean-up Days* – The JST has also begun organizing the first department-wide clean-up days where labs can dispose of their unknown waste, old equipment, electronics, and other unnecessary clutter that accumulates in lab. This will greatly improve the safety of labs by reducing clutter, unknown chemicals, and hazardous waste.
- **Education:** *Technical Workshops* – The JST will be organizing technical safety workshops that will be offered to graduate students on specific topics such as handling and measuring pyrophoric chemicals (*tert*-butyl lithium, diethyl zinc), cyrogens, spill kits, etc. These workshops are intended to be small (4-8 students), hands-on, and will be excellent learning experiences for new researchers and students wanting to improve their safety knowledge.

Organization

The JST is made up of all LSOs from CHEM and CEMS generally and organized into the following committees.

- *Administrative Committee (Admin Comm)*: Seven people serve for one year – six chairs of other committees, one chair of this committee. All are elected into this committee. This committee organizes meetings with parties from the Dow Chemical Company and the University of Minnesota to assure that the goals of the safety initiative are being actively pursued in an efficient and reasonable manner.
- *Public Relations and Signage Committee (PR)*: Open to all who want to serve – one chair is elected and serves for one year. This group will be focus on creating and sharing slogans, posters, and general knowledge signs both in and out of the laboratory.
- *Personal Protective Equipment Committee (PPE)*: Open to all who want to serve – one chair is elected and serves for one year. People in this group will seek to improve the availability of PPE that we don't currently have access to, such as acid aprons, gloves more resistant than nitriles, etc. Additionally, this group will seek to improve the accountability of both students and professors by, e.g., having students conduct audits of other labs or getting professors to formally audit laboratories.
- *Education and Resources Committee (E&R)*: Open to all who want to serve – one chair is elected and serves for one year. This group will focus on what information and resources are available to students. The basic goals will involve promoting both general resources available to all students as well as more topical concerns (e.g., high pressure gases, mechanical connections, glassware safety, ergonomics, etc.).
- *Technology Committee (Tech)*: Open to all who want to serve – one chair is elected and serves for one year. This committee has developed and maintains our website (http://www.jst.umn.edu) and our email address (jst@umn.edu). This committee will also be in charge of sending out a quarterly survey to gauge the culture of safety on campus.
- *Department of Environmental Health & Safety Officer (DEHS)*: Open to all who want to serve. This officer establishes regular interactions with DEHS to get rid of chemicals, instruments, equipment, etc.
- *Finance Officer*: Open to all who want to serve – This officer will be responsible for determining the monetary feasibility of our proposals. This committee will also be in charge of the JST budget.

All committee chairs and officers are elected by majority vote by all JST members. When a chair is planning to step down, the new chair will be elected and serve as chair-elect for 2 months prior to official transfer of position.

Roles and Responsibilities of a Lab Safety Officer

Each active laboratory at the University of Minnesota must have a lab safety officer (LSO). The LSO serves as a resource for ensuring safe practices in the lab as well as serve as a role model for safety. Larger groups may have more than one LSO if needed in order to fulfill all duties.

Responsibilities of an LSO are divided into a few groups…

JST Responsibilities:

- Be an active member in the Joint Safety Team (JST). Each LSO should attend JST meetings at a minimum and have the opportunity to contribute more by serving on one of the JST committees. LSO's must have a representative from their group attend if they are unable to.
- Participate in two sets of other lab housekeeping walkthroughs per year (organized by the JST Audit committee).
- Attend LSO Training Sessions when offered by the JST.

Group Responsibilities:

- Assist in the writing, evaluation, identification of areas in need, and sharing of laboratory specific standard operating procedures (to be reviewed yearly) with your PI.
- Maintain records for your lab regarding yearly safety training, lab specific training procedures and eyewash station testing. LSOs do not need to lead all trainings, but are in charge of keeping accurate records of training events.
- Know the proper steps for reporting incidents. Encourage your group to fill out a Learning Experience Report (LER) online at http://www.jst.umn.edu/incident.html
- Be able to identify safety showers, eye washes, first aid, fire extinguishers, etc. in each lab and ensure every new member learns where these are located.
- Ensure the maintenance of group safety equipment such as spill control kits, fire extinguishers, safety showers, first aid kits, and eyewash facilities.
- Perform weekly checks of eye wash and maintain first aid kit. Documents for recording these checks can be found here: http://www.dehs.umn.edu/ressafety_rsp.htm or http://jst.umn.edu
- Maintain proper laboratory signage, including: minimum PPE requirements, emergency contact information (updated for every new member or at least once every 3 months). Templates for these can be found here: http://www.jst.umn.edu/
- Organize safety moments at group meetings. Group members should be encouraged to come up with their own content, although possible content can be found here: http://www.jst.umn.edu/
- Be familiar with hazardous waste requirements and storage. LSOs are *not* responsible for the packaging and disposal of waste for their group, unless appointed by their PI.
- LSOs are expected to be a role model for safety. This includes adhering to all PPE requirements and setting a good example for their lab mates. Remind researchers of the minimum PPE requirements if they have forgotten. LSOs are encouraged to seek assistance from their PI if a researcher ignores these requirements.
- Conduct inspections of your group's laboratories.
- Mentor next LSO for 2 months before leaving position.

General Responsibilities:

- Be familiar with emergency procedure information (what to do, where to go, etc.). Documents on procedures can be found here: http://www.jst.umn.edu/
- Read and have a clear understanding of The Chemical Hygiene Plan of your department:
  - Department of Chemistry: http://www.chem.umn.edu/services/safety/ChemHygPlan.html
  - Department of Chemical Engineering and Materials Science: http://www.cems.umn.edu/about/safety/cems_hyg_plan.pdf
- Be able to find MSDSs and understand how to read them.

Transferring the LSO Position and Duties

If you are transferring the LSO position to a different lab group member or are taking the LSO position on, you must complete the following steps.

Steps you need to take when LEAVING the LSO position:

1. Make sure your PI is aware and has appointed a person from the group to take over the LSO position.
2. Mentor the next LSO for two months before leaving the LSO position completely.

Steps you need to take when BEGINNING the LSO position:

1. Make sure you have PI approval.
2. Be mentored by the previous LSO for a minimum of two months before taking on the LSO position fully.
3. Read and understand the *LSO Guidebook.*
4. Attend the JST meetings along with the current LSO.
5. Complete the *LSO Training Record* (located in **Section 3:** Training and Maintenance Records, p. 19).
6. Attend an LSO training session when it is available.
7. Email jst@umn.edu with the following:
   - Name of previous LSO (if this person is to be removed from the mailing list).
   - Name of new LSO, email address, phone number, office building and number.
   - Name of principal investigator.

It is essential to have good communication with your PI and your group when changing LSO positions. Your group members need to be aware of the transition and know who is in charge of the safety of their group. It is also essential you have a full understanding of the LSO responsibilities and duties so that you can communicate to your group what they are expected to do in terms of training, PPE, hazardous waste, etc. You are committing to your PI and group that you are responsible for making sure they complete their necessary training. For larger groups, it may be beneficial to have more than one LSO to ensure all safety needs are met.

Guidelines for a Safer Lab

1. All researchers must wear basic PPE, including:
    a. Closed-toe shoes
    b. Long pants
    c. Safety glasses
    d. Lab coat (to be washed as necessary)
        i. Lab coats must be worn in all labs unless by PI exemption.
        ii. Lab coats can be worn when crossing between labs on same floor.
        iii. Lab coats should *not* be worn in non-chemical areas (offices, restrooms, etc.).
    e. Additional PPE, such as splash goggles or gloves, should be worn as appropriate.
        i. Gloves should *not* be worn when crossing between labs.
2. There should be no food or drink in labs.
3. Aisles and hallways should be kept clear of chemicals and clutter.
4. All electronics near possible leakage sources (including safety showers) should be off of the floor.
5. Do not work in the laboratory alone, unless extenuating circumstances require it. Even then, inform a colleague that you are in the lab and what you are doing, in case of emergency.
6. When working in a wet chemical lab, *do not* raise hood sashes above the minimum level. (Exception: during reaction glassware set up when no other chemistry is occurring in the hood.)
7. Proper laboratory signage must be posted, which includes:
    a. Emergency contact information
        i. Emergency personnel contact information (DEHS, fire, etc.)
        ii. Group member contact information (updated every time a new member joins)
    b. Minimum PPE required for lab
    c. Various hazard information as appropriate for lab
8. Proper storage of chemicals includes:
    a. All chemicals must be in secondary containment in appropriate cabinets or on the bench-top.
    b. Liquid chemicals should not be stored above eye level.
    c. *At a minimum* all chemicals should be separated and stored by hazard class, which are:
        i. Flammables
        ii. Corrosives
            1. Acids
            2. Bases
        iii. Oxidizers
        iv. Highly Reactives
        v. Extreme Toxics/Regulated Materials
        vi. Low Hazard
9. Proper handling of samples includes:
    a. Properly labeled according to OSHA standards, including:
        i. Owner name, notebook, page number
        ii. Date created
    b. Properly stored in secondary containment and separated by hazard class (see above) which is clearly labeled on the containment.
    c. Properly disposed of or passed on when a student graduates so as to prevent buildup of clutter and unknown hazardous waste.
10. Proper storage of waste includes:
    a. Labeled with contents.
    b. Capped or sealed unless in use.
    c. Waste should be properly disposed within 90 days of creation.
11. Maintain SOPs, to be reviewed and updated as needed or at least once a year.

Safety Contact Information

Safety Committee – Department of Chemistry

The Chemistry Safety Committee assists the chairperson with the development and implementation of the Department's Chemical Hygiene Plan (CHP). The Chemistry Safety Committee provides advice and assistance to laboratory supervisors with regard to the training of Chemistry Department personnel and the implementation of the CHP. The Chemistry Safety Committee is chaired by the Department's Chemical Hygiene Officer.

The Members of the Chemistry Department Chemistry Safety Committee (2013) are:

- Anna Sitek - Research Safety Specialist (DEHS Staff)
  - Email: ..... engl0131@umn.edu
  - Phone: 612-625-3084
- Professor Andreas Stein, Faculty Representative
  - Email: ..... a-stein@umn.edu
  - Phone: 612-625-1802
- Chuck Tomlinson, Department Administrator
  - Email: .....chuck1@umn.edu
  - Phone: 612-624-2321
- Ted Tolaas, Teaching Lab Coordinator
  - Email: ..... tolaa001@umn.edu
  - Phone: 612-624-5585

Safety Officer – Department of Chemical Engineering and Materials Science

- Professor Raúl A. Caretta
  - Email: ..... caretta@tc.umn.edu
  - Phone: 612-625-8066

For other safety numbers and emergency contacts, please see Emergency Contacts (Section 4, pp. 63–64).

What is an SOP?

A Standard Operating Procedure, or SOP, is a document that provides the rules, regulations, and specific procedures followed by all employees, or personnel, associated with a group. In the field of scientific research, SOPs should be used in all laboratory procedures and activities, regardless of the type of research performed. The SOP ensures that a laboratory is adhering to all of the safety protocols established by federal and/or state agencies as well as all policies set forth by the company or university the laboratory is associated with. The second function of an SOP is to ensure that all personnel working in a laboratory are using the same procedures and following all of the same regulations in the laboratory. This not only helps to reduce breakages, accidents, and injury in the laboratory, but also establishes continuity of laboratory operations when a new hire joins the lab or when a senior member leaves the laboratory. SOPs for each laboratory will vary between labs, based on the type of research performed and the regulations imposed by the federal and state authorities, the company, and the university. The following section provides the guidelines on what *should* be included when writing a laboratory SOP as well as guidelines on how to maintain an SOP.

Writing and Maintaining Laboratory Standard Operating Procedures (SOP)

1. PURPOSE: Provide guidelines for writing and maintaining effective SOPs in order to maintain continuity of research and safe working environment in the laboratory

At a minimum, an SOP should include the following:

1. Minimum PPE required for your laboratory
2. Clear instructions for common laboratory procedures (e.g. storage of chemicals and glassware, handling of waste, etc.)
3. Safety Instructions for working with specialty equipment and chemicals (e.g. lasers, pyrophoric chemicals, oxidizers, compressed gases, etc.)
4. Basic operating instructions for laboratory equipment (fume hoods, pH meters, water bath and probe sonicators, chromatography/mass spectrometry systems, Rotovaps, X-ray equipment, vacuum systems, etc.)
5. Safe and proper use of any specialized PPE used in your laboratory (dry boxes, glove boxes, respirators, etc.)
6. References and locations/websites for MSDSs, user manuals, etc. for ALL laboratory equipment, specialty PPE, and specialty chemicals used in your lab
7. Signatures of the laboratory PI and the LSO

An SOP should serve as a quick reference guide for all established procedures in the laboratory. It should be a supplement to an MSDS for a specific chemical or a user/hardware manual for a specific piece of laboratory equipment.

THE SOP SHOULD NOT BE USED AS A SUBSTITUTE FOR AN MSDS OR A HARDWARE/USER MANUAL.

2. ORGANIZING AND WRITING THE SOP

a. Introduction The introduction of a laboratory SOP should begin with a brief overview of the type of research and techniques commonly performed in the lab. This will give a new member of the laboratory a good idea of the level of PPE, technical knowledge required, and overall safety protocols implemented in the laboratory.

b. Body

1. Minimum PPE required for your laboratory

All laboratories, in both industry and academia, require some level of PPE for personnel working there. The level of PPE will be dependent upon the type of research performed. At minimum, most labs require a lab coat, gloves (typically latex or nitrile), and laboratory splash goggles. This section should only be a list of the minimum PPE required to work in the lab. This list should also be posted on the outside of the doors of the lab.

2. Clear instructions for common laboratory procedures

There are many techniques and procedures that are commonly used in both industrial and academic laboratories. Although these techniques and procedures are essentially the same, each laboratory may have a way in which they must be performed. This ensures that everyone working in the lab follows the same procedures and helps to minimize the loss of productivity in the lab. Another reason for the subtle differences in basic procedures is that the laboratory may be required to adhere to regulations imposed by federal/state agencies (such as OSHA or the FDA) or by company/university policies.

When writing SOPs for these procedures, find out what policies the laboratory must follow to ensure that your SOPs are in compliance. Most agencies (and possibly some universities with large research programs) may have their *own* SOPs for basic laboratory procedures. You will save a lot of time and frustration if you incorporate these procedures into your lab SOP. If you fail to do this, the laboratories could face hefty fines, lose funding, or ultimately be shut down.

3. Safety instructions for working with specialty chemicals

Certain chemicals and laboratory equipment have specific hazards associated with them. The types of chemicals and equipment that is used in your lab will depend upon the type of research and experiments your lab performs. Please refer to the List of Common SOPs (p. 13) for examples of hazards that would require an SOP.

The MSDS should be used as a key reference to write the SOP for safe and proper handling of each chemicals and/or piece of equipment. However, the SOP is **NOT** a substitute for the MSDS. When writing the SOP for these specialty items, the MSDS should be referenced and easily accessible to everyone working in the lab.

4. Basic Operating Instructions for laboratory equipment

Laboratories that perform certain types of research require specialized or "home-made", and often expensive, equipment. Basic procedures for these instruments, such as start-up, routine analysis/maintenance, and shutdown, are written specifically to prevent injury to the user and damage to the equipment. These procedures can be found in the User Manual, which should be used as a template when writing your laboratory SOP. More technical procedures, such as replacing parts, are also described in the User Manuals, but do not need to be included in the SOP. However, the reference and location of the User Manuals should be included.

This is especially important when writing an SOP for a "homemade" piece of equipment. In this case, you should carefully annotate all procedures performed for ALL basic procedures. Since these pieces of equipment often consist of parts with multiple model numbers or manufactured by multiple vendors, you should reference ALL manuals used to perform the procedures.

5. Safe and Proper Use of Specialized PPE used in your lab

Laboratories that routinely use specialty chemicals may require the use of special PPE such as a respirator. This information should be listed in the MSDS corresponding to the chemical. At the University of Minnesota, DEHS and the Office of Occupation Health can provide detailed information on the proper use of such specialized PPE. Prior to writing the SOP for these items, use the MSDS to verify that specialty PPE is required for handling certain chemicals and then consult DEHS and/or the Office of Occupational Health for proper use.

c. References and Signatures

1. References

It is extremely important to provide references to the key documents used to write your SOP such as MSDSs and User/Hardware Manuals. If you choose to use other sources to write the SOPs, ensure that they are CREDIBLE (e.g. OSHA and/or DEHS regulations, DEHS, University Chemical Hygiene Plan, etc). Prior to writing your SOPs, it is also important to verify that ALL documents you reference and use are easily available and accessible to your labmates.

2. Signatures

Your SOP should not be put into practice or made available to your labmates until the PI of your lab has reviewed, approved, and signed all SOPs you are planning to implement in your lab.

3. MAINTAINING YOUR SOPs

Maintaining your SOPs is just as important as establishing a SOPs for your laboratory. The purposes of maintaining your SOPs are:

- Ensure your laboratory remains in compliance with any new policies or changes in policy established by federal and state agencies and the university

- Provide up-to-date training for all members of the laboratory upon use of new technique in your lab, arrival of a new piece of equipment, upgrade of new piece of equipment, etc)

Although there is no specific timeframe to review your SOPs, you should do it prior to receiving a new member in the lab, when changing LSOs, prior to ANY laboratory inspection, or whenever your LSO or PI requests a review.

4. CONCLUSION

Laboratory SOPs will vary from lab to lab based on the type of laboratory, research performed, and regulatory policies they are subject to. An SOP is not meant to be a rigid set of instructions, it is a flexible document meant to provide a safe environment for anyone working in the lab without sacrificing the productivity of the research performed. This document should be used as a guideline and is meant to provide recommendations for writing an effective laboratory SOP that is applicable to any research laboratory.

List of Common Laboratory SOPs

This list is not meant to be exhaustive or required for every group. It is meant to act as a guide and represents a variety of topics that are present in current SOPs in CHEM and CEMS. For more examples or detailed write-ups of these topics, please refer to the SOP binder for CHEM in Smith 115. The LSO should determine which procedures require an SOP in conjunction with their PI.

Note: This list is intended to give representative examples of procedures/techniques/equipment that would require an SOP.

Reagents:

- Explosive compounds (azides etc.)
- Sure-seal compounds (*n*-BuLi etc.)
- Raney Nickel
- Perchloric Acid
- Silica Particles/Gels
- Solid pyrophoric materials ($LiAlH_4$, NaH etc.)
- Reactive metals (Na, Li, K etc.)

Equipment:

- Rotary evaporators
- Vacuum ovens
- Schlenk lines
- High-vacuum pumps
- HPLC, GC/GC-MS
- Polarimiter
- Autoclave
- Sonicator
- Centrifuge
- Unisoku dewar
- Vacuum ovens
- Digital pH meters
- Syringe Pumps
- LCxLC, LCxLC-MS
- HPLC column packer
- High pressure liquid N_2 tanks
- XRD
- GPC/SEC
- Resonance Raman
- Pellet press
- Superconducting magnets
- Gas cylinders and regulators
- Glove box
- Hydrogenation bomb
- Microwave reactor
- Solvent purification system/solvent stills
- Argon ion laser

Techniques:

- Reagent preparation (LDA, NBS recrystallization etc.)
- Recrystallization
- Distillation
- NMR sample preparation
- IR sample preparation
- Liquid N_2 traps
- Preparation/Modification of silica
- Packing HPLC columns
- Filtration
- Extractions (Liquid-liquid, SPE, SPME, etc)
- Chemical Vapor Deposition (CVD)
- Preparation of commonly used HPLC mobile phases (buffered solutions, anything containing perchloric acid)
- Syringe/cannula transfer
- Vacuum transfer of solvents using a Schlenk line
- UV-vis and cryostat
- React-IR
- Electrochemistry

Biologics:

- Cell culture maintenance
- Recombinant DNA
- Biological safety equipment

EXAMPLE: DEHS Standard Operating Procedure

Title:_____

PI:_____ ***Lab Location:***_____

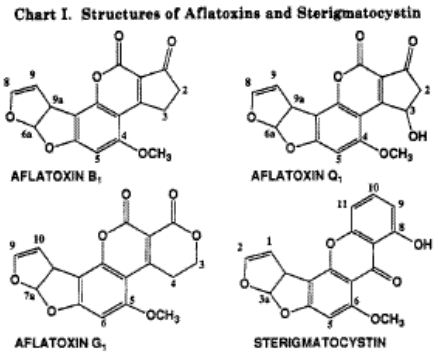
Issue Date:_____ ***Revision Date:***_____

Prepared by:_____ ***Approved by:*** _____

Hazard Identification:

Physical-Chemical Properties

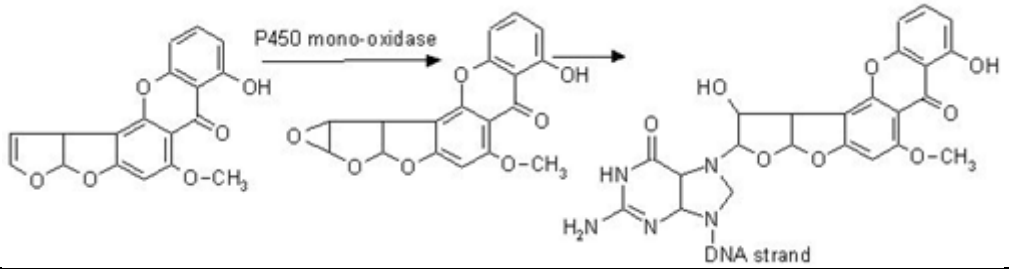
- CAS# _____
- Molecular formula _____
- Molecular weight _____
- Form _____
- Solubility _____
- Volatility _____
- Other _____



Toxicity

- Acute effects _____
- Chronic effects _____
- Local effects _____
- Systemic effects _____

Sterigmatocystin activation
(http://www.biocentrum.dtu.dk/mycology/home/monthly_fungus/2002_01/)



Exposure Assessment:

Route

- Inhalation _____
- Skin/eye absorption _____
- Accidental ingestion _____
- Accidental injection _____

Duration

- frequency _____
- length _____

Control Plan:

Work in a ventilated enclosure (fume hood) equipped with spill control.
Wear nitrile gloves, goggles and labcoat.
No eating or drinking in the lab.
Wash hands and face thoroughly after lab work.

Note1: Aflatoxin in chloroform can diffuse through latex and vinyl gloves (IARC). It is likely that sterigmatocystin solutions would behave similarly. Therefore, wear a laminated glove such as a Silvershield or a 4H for working with ST-solutions.
Note2: To avoid dispersion of the powder due to electrostatic effects, solid ST should be handled using cotton gloves.

Experimental Procedures:

Waste Management Procedures:

ST is completely degraded by an excess of sodium hypochlorite solution (bleach) followed by addition, after dilution, of acetone to destroy potential hazardous dichloro derivatives. 200 μg of ST in 4 mL of methanol are completely degraded by treatment of 5 mL of a 5°Cl hypochlorite solution for 1 hr. Further treatment with acetone removes potential mutagenic compounds. (IARC)

Availability of chlorine is expressed as °Cl. A 1 mol/L solution of hypochlorite corresponds to 22.4°Cl. (IARC)

Collect mixture in compatible container and label as Hazardous Waste.

Spill and Accident Procedures:

References:

Raney et.al., Chem Res. Toxicol., 1992, 5:202-210. (Chart I)
RTECS (Registry of Toxic Effects of Chemical Substances), 12/30/2003
IARC Scientific Publications No.113 "Laboratory Decontamination and Destruction of Carcinogens in Laboratory Wastes: Some Mycotoxins", 1991, Lyon, France.
Noda et. al., Carcinogenesis, 1981, 2(10):945-949.

Source:

http://www.dehs.umn.edu/ressafety_rsp.htm

EXAMPLE: Group Specific SOP

5.2 Solvent Stills

I. Introduction

The **** Group currently has five amine stills (triethylamine, pyridine, diisopropyl amine, diisopropylethyl amine, and hexamethyldisilazane) and three solvent stills (tetrahydrofuran, diethyl ether, dioxane). These are located in *** Building, Room ***. The amine stills contain the corresponding amine and calcium hydride as a drying agent. The solvent stills contain the corresponding solvent, sodium metal, and benzophenone.

*Before using the solvent or amine stills please review the DEHS fact sheet on Pyrophoric Chemicals.

II. Operation

A. Amine Stills

A water circulator is located below the hood where the stills are located. Before using the still ensure that there is ice-water in the bucket and that the water circulator in on (the red switch will be light when on).

Each of the amine stills is affiliated with a variac, which has markings corresponding to the settings at which the solvent will reflux. DO NOT exceed the setting given for reflux, or the temperature will rise more than necessary and the solvent could start to evaporate.

It's good practice to let the solvent reflux for a few minutes in the open stopcock position before collection, to "flush" the system. You should also wait until the collected solvent has cooled before removing it from the reservoir. NEVER reflux a still overnight or leave it unattended.

When collecting solvent, make sure to "protect" the tip of your needle (with a rubber stopper or something similar) when transporting it between your lab and the stills room. Open the needle stopcock and pierce the septum in the same position each time (in the center). Flush your syringe with nitrogen once or twice before drawing up solvent, which should be done slowly. Be sure to close the needle stopcock once you have completed using the still.

Mark your initials and the date distilled on the log sheet. You should distill more solvent than is needed, so that other group members can use the mostly dry solvent later.

B. Sodium/Benzophenone Solvent Stills

Select the flask which contains the appropriate solvent/drying agent combination from the flammable storage cabinet below the hood, (THF has a dedicated heating mantle) place it on the cold heating mantle and assemble it with the drying head, and with the nitrogen supply. Start the water circulator and make sure there is ice in the bucket.

Close the stopcock, which is attached to the sidearm of the upper chamber. Also close the teflon stopcock which leads to the collection port below the upper chamber. Open the teflon stopcock which allows solvent in the upper chamber to flow down to the lower chamber or still pot. Confirm that there are no foreign objects between the heating mantle and the flask. Turn on the heating mantle to a setting appropriate for the solvent listed on the variac.

After reflux has been achieved, wait an hour or until the color of the solution shows that the solvent is dry, whichever is later, and then close the teflon stopcock which allows solvent in the upper chamber to flow down to the lower chamber or still pot. After the desired volume of solvent has accumulated in the upper chamber, turn off the heating mantle.

Remove the collected solvent by either of the following two methods:

A) By using a syringe (flushed twice with argon) with a long needle, passing the needle through a septum and then the stopcock which is attached to the sidearm of the upper chamber, or

B) By attaching a solvent storage flask (**only for THF**) to the collection port below the upper chamber. The male joint of the distillation head has to be purged with nitrogen from a separate hose before the receiver flask is connected. Open the teflon stopcock in the collection port to transfer the solvent, then close the teflon stopcock at the distillation head, and close the receiver flask with a glass stopper while purging with nitrogen.

Open the teflon stopcock which allows solvent in the upper chamber to flow down to the lower chamber or still pot.

After the still pot is cool to the touch, stop the argon and water circulator. Mark your initials and the date distilled on the log sheet. You should distill more solvent than is needed, so that other group members can use the mostly dry solvent later.

**** **** is the contact for the stills. Contact this person IF:

- solvent is running low, or you need a lot of solvent
- the still has changed color and needs attention (ESPECIALLY important with THF)
- nitrogen is not flowing
- water is not flowing
- water is leaking
- a still is leaking
- a septum needs to be changed
- an unattended still is refluxing

Please do not take it upon yourself to add solvent to the stills if they are running low – the group operator will gladly perform this task for you.

III. Quenching Solvent Stills

**This task should only be performed by properly trained personal.*

Stills that use calcium hydride as the drying agent are the easiest to quench. After the majority of the solvent has been decanted away from the drying agent, the remainder, along with the calcium hydride, is poured slowly over crushed ice. The ice is replaced as it melts so that the unreacted calcium hydride is always being added to a solution that consists mostly of ice. Lumps stuck in the still-pot must be carefully removed with a spatula. When nothing but a thin film of hydride remains in the still-pot it can be washed out with cold water.

The quenching of used still-pots, especially sodium pots, is potentially dangerous but can be done safely if appropriate precautions are taken. These include: wearing goggles, labcoat and gloves; working in a well-ventilated hood behind a safety shield; and quenching the reactive compounds slowly.

Sodium-Benzophenone pots require special care.

- The entire quenching process should be carried out under a steady stream of nitrogen with a large opening to vent both the nitrogen stream and the hydrogen gas which is generated.
- Pour off excess solvent, and refill the flask with dry xylene or toluene. Place an ice bath under the still-pot.
- Add a reflux condenser and an addition funnel filled with sufficient isopropyl alcohol to react with 150% of the expected amount of metal.
- The alcohol is added drop-wise, stopping if the solution begins to boil too vigorously.
- After the addition is complete, the solution is heated to reflux for 6 hours.
- The process is repeated with methanol.
- If no bubbling is observed upon addition of methanol a small (1 mL) quantity of water is added to confirm that the metal has been quenched. The final mixture may be safely disposed of in a hazardous waste container.

Training Records

1. PURPOSE: To document all types of training that a lab member will undergo and provide guidance on how to keep and maintain the training records

At a minimum, every researcher should participate in:

1. Yearly safety training as sponsored by the Department of Health and Safety (DEHS);
2. Lab specific training for lab specific hazards, potentially based on hazards present in the Standard Operating Procedures for the lab (see Section 2).

As an LSO, it is your responsibility to maintain the documentation of (1) and (2). The JST recommends maintaining these documents in this binder, and keeping those records until three years after the researcher has departed the lab. These guidelines are supposed to represent the minimum requirements for a lab, if your lab decides further documentation of training is necessary, please feel free to add documents to this binder to reflect that.

2. TEMPLATES

Two templates are present for maintaining the training records. DEHS has provided an exhaustive template, and can serve as a record for many researchers. A new one would need to be filled out each year after the required yearly safety training. The other template is a single record for each researcher that is updated when new trainings are received. Either is appropriate and need to be amended to include lab-specific training protocols based on the hazards or training described in the SOP for the lab.

3. EYEWASH CHECKLIST RECORDS

Records of the weekly eyewash inspection need to be maintained for a year past the date of inspection. Those records can be kept here. See Section 4 for the Eyewash Inspection template and guidelines.

4. OTHER RECORDS

Other records may also be kept in this binder, but it is up to the discretion of the LSO. Examples may include but are not limited to: results of safety inspections, accident reports, near-miss reports, or other safety related documents that would aid in the training of an LSO.

Training Record
Lab Safety Officers

Please use this form to document the training of new Lab Safety Officers (LSOs). Each LSO who has signed this form has read and understood the Standard Operating Procedures (SOPs) for the lab, been informed of the duties and responsibilities of an LSO and has agreed to carry out these responsibilities with the endorsement of the Principal Investigator (PI) for the lab.

LSO Name	LSO Signature	PI Signature	Date

The University of Minnesota

Lab-Specific Hazard Communication Training Record

The University requires documentation that all laboratory personnel have received Lab-Specific Hazard Communication training. This training is provided by the Principal Investigator (PI) or their designee.

Principal Investigator: X500:

Department:

This checklist is to assist the PI in providing training as described in the OSHA Laboratory Safety Standard and the University's Research Safety Program. It is the Principal Investigator's responsibility to ensure all research laboratory personnel (employees, students, visiting researchers) are trained. This training must be provided initially upon beginning work in the laboratory and at least annually thereafter.

In addition, the Department of Environmental Health and Safety (DEHS) requires employees to take safety refresher training annually. Please contact your Department's Research Safety Officer for information regarding safety refresher training or the DEHS web site. Additional site-specific training topics should be covered based on the hazards in your lab as appropriate. Training resources are provided on the DEHS web site.

Review the following:

General checklist:	**Yes**	**No**	**N/A**
1. Lab-specific standard operating procedures (SOPs) for the safe handling and use of chemicals and all laboratory apparatus.	☐	☐	☐
2. Hazardous materials (chemical, biological, radioactive) training	☐	☐	☐
3. Physical and health hazards (acute and chronic) associated with the materials	☐	☐	☐
4. Signs and symptoms associated with exposures to hazardous materials in the lab	☐	☐	☐
5. Methods and observation techniques to determine the presence or release of hazardous materials	☐	☐	☐
6. Precautions that will be taken to mitigate hazards	☐	☐	☐
7. Procedures for using safety equipment including fume hood, biosafety cabinets, etc.	☐	☐	☐
8. Location of signage including safety signs and emergency numbers	☐	☐	☐
9. The lab's housekeeping procedures, cleanup schedule	☐	☐	☐
10. Procedures for transporting hazardous materials safely across campus	☐	☐	☐
11. Inform personnel how to access DEHS safety training modules	☐	☐	☐

Chemicals:	**Yes**	**No**	**N/A**
1. Storage location of chemicals and their segregation by compatibility	☐	☐	☐
2. Requirements for chemical labeling on primary and secondary containers	☐	☐	☐
3. Use, storage, and handling of gas cylinders and cryogenics	☐	☐	☐

4. Use of specific chemicals that would warrant exposure monitoring	☐	☐	☐
5. Chemical waste program information	☐	☐	☐

Biological:	**Yes**	**No**	**N/A**
1. Biosafety Manual and Exposure Control Plan Policies and Procedures	☐	☐	☐
2. Decontamination and disinfection procedures	☐	☐	☐
3. Biological Decontamination & Spill Clean-up Plan Template	☐	☐	☐
4. Biohazards and Toxin Decontamination & Spill Clean-up	☐	☐	☐

Radioactive:	**Yes**	**No**	**N/A**
1. General requirements (posting, training, security)	☐	☐	☐
2. Food and beverage prohibition	☐	☐	☐
3. Proper laboratory attire (Lab Safety Plan) see also PPE below	☐	☐	☐
4. Contamination surveys and instrumentation	☐	☐	☐
5. Radioisotope spills and emergencies	☐	☐	☐
6. Permit Holder responsibilities	☐	☐	☐
7. Radioisotope purchasing and transfer	☐	☐	☐
8. Radioactive waste management/disposal	☐	☐	☐
9. GM operation and survey protocol	☐	☐	☐
10. Record keeping requirements	☐	☐	☐
11. Personnel monitoring and dosimetry	☐	☐	☐
12. Prenatal exposure guide	☐	☐	☐
13. ALARA considerations	☐	☐	☐

Equipment:	**Yes**	**No**	**N/A**
1. Autoclave, high pressure, and other potentially dangerous equipment use and safety training	☐	☐	☐
2. Hand washing sink	☐	☐	☐
3. Biological Safety Cabinet use and training	☐	☐	☐
4. Safe use of chemical fume hoods	☐	☐	☐

Personal Protective Equipment (PPE):	**Yes**	**No**	**N/A**
1. PPE requirements for personnel including selection, maintenance and use	☐	☐	☐
2. How personnel can obtain PPE and how to dispose of after use	☐	☐	☐

Emergency Response:	**Yes**	**No**	**N/A**
1. Handling incidents in the lab including exposures, needle sticks and applying first aid	☐	☐	☐
2. Location of emergency equipment including spill kits, fire extinguishers and alarms	☐	☐	☐

3. Emergency shut-offs, eyewashes, and safety showers	☐	☐	☐
4. Emergency procedures including evacuations and spill clean-up (contact DEHS)	☐	☐	☐
5. How to contact Occupational Health in the event of an injury	☐	☐	☐

Waste:	**Yes**	**No**	**N/A**
1. Processes and locations for proper waste disposal in your department	☐	☐	☐
2. How to request and safely dispose of chemical, biological, and radioactive waste	☐	☐	☐
3. Procedures for disposal of highly toxic chemicals, carcinogens or chemotherapeutics	☐	☐	☐
4. Correctly labeling and storing hazardous waste and waste containers	☐	☐	☐
5. How to adequately clean-up or sanitize your lab equipment and work areas	☐	☐	☐

Documentation:	**Yes**	**No**	**N/A**
1. Location of Material Safety Data Sheets and lab-specific SOPs	☐	☐	☐
2. Copy of the current Departmental Laboratory Safety Plan	☐	☐	☐
3. Location of Training Records for all laboratory personnel	☐	☐	☐
4. Incident report forms	☐	☐	☐
5. Hazardous Waste Guidebook, Radiation Protection Manual and Biosafety Manual	☐	☐	☐
6. Recent laboratory inspections and self evaluations	☐	☐	☐

Occupational Health:	**Yes**	**No**	**N/A**
1. Occupational Health requirements	☐	☐	☐
2. How to get vaccinated, medically evaluated, or fitted for respiratory protection	☐	☐	☐
3. Location and contact information for the Occupational Health Clinic	☐	☐	☐

Additional Site Specific Topics: **(**Describe any additional topics covered during the training.)

Certification:
In accordance with the OSHA Laboratory Safety Standard and the University's Research Safety Program, the individuals listed below have attended a training session covering the topics in this training checklist.

Name	X500	Date

I certify that the topics indicated on this training checklist were covered (as applicable) in this training session.

Instructor: **x500:**

Date of training: **Location of Training:**

Training Record
General Safety

Employee Name: _____ Employee x500: _____

Employee Signature: _____

Date

1. Online training for new researchers (http://www.dehs.umn.edu/training.htm)
    a. Introduction to Research Safety _____
    b. Chemical Safety _____
    c. Chemical Waste Management _____

2. Employee knows:
    a. Location and use of safety equipment (shower, eyewash, fire extinguisher, exits) _____
    b. Location of emergency contact information _____
    d. Location of and has read the group-specific SOPs _____

3. Yearly refresher safety training offered through DEHS
    a. 1st year _____
    b. 2nd year _____
    c. 3rd year _____
    d. 4th year _____
    e. 5th year _____
    f. Additional _____

4. Other training:
    a. Unknown Waste Testing (DEHS) _____
    b. _____
    c. _____
    d. _____
    e. _____
    f. _____

5. Other training (lab specific):
    a. _____
    b. _____
    c. _____
    d. _____
    e. _____
    f. _____

EXAMPLE: Training Record
Lab Specific Safety
Group Name

Employee Name:_____ Employee x500: _____

Employee Signature:_____

Check

1. Pyrophoric Liquid Reagents (measuring alkyl lithium reagents, Sure-seal)

- read the SOP ☐
- read Sigma-Aldrich Technical Bulletin AL-134 ☐
- successfully demonstrated under supervision of a trained person ☐

Name (print):_____

Name (signature):_____ Date:_____

Signature:_____ Date:_____

2. Pyrophoric Solid Reagents (weighing Na metal)

- read the SOP ☐
- successfully demonstrated under supervision of a trained person ☐

Name (print):_____

Name (signature):_____ Date:_____

Signature:_____ Date:_____

3. Quenching Reactive Metals (Na^0, BuLi, LAH)

- read the SOP ☐
- successfully demonstrated under supervision of a trained person ☐

Name (print):_____

Name (signature):_____ Date:_____

Signature:_____ Date:_____

4. Gas Cylinders: Operation, Regulators, and Transporting

- read the SOP ☐
- successfully demonstrated under supervision of a trained person ☐

Name (print):_____

Name (signature):_____ Date:_____

Signature:_____ Date:_____

5. Solvent distillations (set-up and use of THF, amine stills, etc)

- read the SOP ☐
- successfully demonstrated under supervision of a trained person ☐

Name (print):_____

Name (signature):_____ Date:_____

Signature:_____ Date:_____

6. High Vacuum Pumps

- read the SOP ☐
- successfully demonstrated operation under supervision of a trained person ☐

Name (print):_____

Name (signature):_____ Date:_____

Signature:_____ Date:_____

7. Schlenk-Line Techniques

- read the SOP ☐
- successfully demonstrated under supervision of a trained person ☐

Name (print):_____

Name (signature):_____ Date:_____

Signature:_____ Date:_____

Chemical Spills: Emergency Procedures

It is always possible for a chemical spill to occur in a laboratory even when following all of the chemical hygiene rules and working safely. Most of the time, spills in the laboratory involve relatively small quantities of materials. However, even small amounts of highly toxic or highly reactive materials can be life threatening and dangerous. Laboratory personnel can clean up some spills. However, there are a number of circumstances that outside assistance should be requested.

As a part of your obligations as a lab safety officer, you must know and follow an emergency procedure if you encounter a chemical spill. The exact procedure you should follow can vary, depending on the chemicals you use. However, in general, follow these steps:

1. Evacuate

- Evacuate everyone from the spill area.
- Shut off electrical equipment as you leave the area.
- Direct everyone to the nearest fire exit. Do not use elevators.
- Provide assistance to those that need help exiting the area.
- Alert your neighbors.

2. Provide Emergency Aid

- Immediately remove any contaminated clothing
- Flush skin or eyes with running water for at least 15 minutes. Caution: You may not feel any immediate effect from chemical spills, but it is very important to wash quickly and thoroughly. Many chemicals can cause severe tissue damage that is not apparent until hours later.
- Resume a water wash if pain returns.
- Get medical attention.
- Make sure medical personnel understand exactly what chemicals are involved.

3. Confine the emergency

- Close fire doors.
- Establish exhaust ventilation if possible.
- Vent fumes only to outside of building.
- Open windows, if possible without exposing yourself to fumes.
- If vapors or gases are in a room that is not vented to outside of building, close off room.

4. Report the emergency

- Call 911 for:
  - spills that involve injury requiring medical treatment,
  - spills that involve fire or explosion hazards,
  - spills which are potentially life threatening, and
  - all chemical spills after work hours (4:30 PM – 7:45 AM).
- Call DEHS at (612) 626-6002 (or call 911 and say "*Call AHERPS*") for:
  - spills of 500 mL or more of a chemical, or any quantity of a highly reactive or toxic material,
  - metallic mercury spills,
  - spills of an unknown chemical,
  - spills you do not have proper training or proper protective equipment to do the cleanup, and/or
  - spills for which you have any questions or doubts about your ability to clean up the spill.

The type of information you will need to provide when you call 911 and DEHS is:

- your name, telephone number and your current location
- location and time of the incident
- type of incident
- chemical name and quantity involved
- extent of any injuries
- possible hazards to human health or the environment

Always report a spill to the departmental office, regardless of who cleans up the spill.

5. Secure the area

Until emergency responders arrive on the scene, you and your staff will have to block off entrances to the spill site and prevent people from entering the contaminated area.

- Lock doors leading to the chemical spill and post signs on doors warning of the spill.
- Tape or rope off stairwells and elevators leading to the spill and hang signs on the tape.
- Contact Facilities Management if there is a potential for vapors or gas to spread throughout a building's ventilation system.
- Post staff by commonly used entrances to the spill site, so they can warn people to use other routes.
- For large outdoor chemical spills, keep people upwind and uphill from the site.

6. Clean Up

Laboratory personnel can cleanup low hazard level spills. Low hazard level spills are those spills that do not spread rapidly, do not endanger people and do not endanger the environment. All other spills are high hazard level spills and require outside assistance.

For high hazard spills either EHS or the fire department will clean up or stabilize the spill. High hazard spills are those that present fire, health or reactivity hazards. If assistance has been requested from EHS, and it has been determined that the spill can be safely cleaned up by laboratory personnel, they will provide advice on how to safely clean up the spill.

Based on the procedures you develop for your own work (or that your supervisor has developed), you will need to clean up low hazard spills. DEHS will gladly provide advice on what precautions and equipment to use. When cleaning up a low hazard spill the proper clean up procedure must be known. If experimental work has been properly planned, this information should be readily available. The appropriate personal protective equipment should be worn and any hazardous waste should be disposed of appropriately. The following guidelines are intended to aid in chemical spill cleanup:

1. The spread of dusts or vapors can be prevented by closing the laboratory door and increasing the ventilation (for example, through the fume hood).
2. The spread of a liquid spill can be controlled by making a dike around the edges of the spill using absorbent materials such as vermiculite or spill pillows.
3. Special absorbents are required for some chemicals such as hydrofluoric acid and concentrated sulfuric acid.
4. If flammable liquids are spilled, remove all potential sources of ignition if it can be done safely.
5. In cleaning spills involving direct contact hazards, select personal protective equipment resistant to the chemical. It is a good idea to wear two sets of gloves.
6. Acid spills can be neutralized with soda ash or sodium bicarbonate.
7. Base spills can be neutralized with citric acid or ascorbic acid.
8. Cleanup residues should be placed in a plastic bucket or other suitable container and disposed of through the Chemical Waste Program.

In Chemistry, there are two conveniently located spill kit carts, either of which may be moved to the location of the spill. These carts are located in:

- Kolthoff - the northwest hallway near 681
- Smith - the hallway by the east elevator on the sub-basement level.

Be sure to alert Chuck Tomlinson to the use of any of the materials on the cart so that they can be replaced.

Resources:

(1) DEHS Chemical Waste Management Online Training
(2) Department of Chemistry Chemical Hygiene Plan

Incident Reporting

If you have had a lab accident or have been injured, you must report the incident by filling out the appropriate form. *If you are unsure of what you need to do, contact your PI.*

Reporting lab accidents and near-accidents can allow others to learn what measures need to be taken when running an experiment. Below are the appropriate forms to fill out in case of an incident and how to report these learning experiences for other University researchers.

Forms for reporting incidents

1. Reporting safety concerns

Maintaining a safe work environment is the responsibility of everyone involved. If you come across a safety concern or hazard, you can report this to the Office of Occupational Health and Safety. You can also use UReport (http://www.ureport.umn.edu) the confidential reporting service for all University of Minnesota campuses.

http://www.ohs.umn.edu/report/home.html

2. Lab incident investigation

Incidents that lead to a chemical spill, fire, or explosion require investigation by the principle investigator. This investigation needs to take place as soon after the incident as possible and the completed form needs to be kept in laboratory records.

Accident Investigation form: http://dehs.umn.edu/docs/accinv.doc

3. Lab injury reporting

In addition to the forms above, specific reporting needs to take place in the event of personal injury due to a work-related incident.
When a lab incident leads to the injury of a researcher, an employee incident report needs to be filled out and reported. Please have either yourself, or better, the principle investigator fill out this form as soon as possible after the incident.

- Employee Incident Report form: https://webapps-prd.oit.umn.edu/froi/

If the injury requires the employee to miss work, a worker's compensation form also needs to be completed to ensure continuing benefits for extended absences due to injury.

- Worker's Compensation: http://policy.umn.edu/Policies/hr/Benefits/WORKERSCOMP_PROC01.html

Learning Experience Reports (LERs)

A Learning Experience Report is a document for recording incidents or situations that *could* have lead to serious accidents (called near-misses). These LERs are in a format that can allow others to learn from the experience. These files will be **anonymous** with a brief description of the incident and the measures that were taken to solve the problem. The form is available on the JST website: http://www.jst.umn.edu/incident.html

These are meant to serve as a learning tool so others may avoid the situation or know how to react in the future.

Encourage your labmates to fill out an LER if they have had a near-miss accident.

Secondary Containment Information

Secondary containment is the container that serves as an additional barrier to a material in the event that the primary container fails. It also serves to isolate incompatible materials from each other.
Examples: trays, beakers, and other impermeable boxes, tubs and containers.

Secondary containment is required for hazardous waste. It should be 10% of the volume of all the containers or the volume of the largest container, whichever is greater. Boxes by themselves do not count.

Secondary containment is recommended for:

- Storage of Hazardous liquids, especially:
  - > 1 L flammable liquids
  - Highly toxic, volatile, air or water-reactive materials
- Active use of hazardous liquids such as reaction flasks and reagent bottles
  - Note- Not required for frequent use containers such as squirt bottles < 1 L
- Non-hazardous Liquids > 5 gallons

It is considered best practice to use secondary containment throughout the lab. Using secondary containment can be helpful to:

- Minimize a spill in a refrigerator
- Minimize a spill in a hood
- Separate incompatible materials and to segregate hazard classes in a storage cabinet.
- Help to organize large numbers of very small containers and reduce labeling issues.

Even with non-hazardous liquids it may be prudent to have secondary containment. A large water event can be very expensive due to mold and equipment damage. Trays can also be useful for keeping solids segregated. Small volume containers are a unique problem. When there are many small containers with similar hazards grouping together in containment trays can help keep the lab tidy and reduce the amount of time spent labeling. The exterior of the secondary container can be labeled (i.e. Flammable) then each interior container does not need a flammable label. This can save time spent labeling.

Non-hazardous solids do NOT need secondary containment.

Photos of common types of secondary containment follow.

All hazardous waste must be in trays.

LIQUIDS

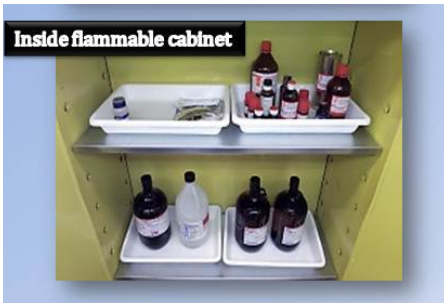
Hazardous Liquids

1) *Storage* (all hazardous liquid materials should be in containment). Below are examples of acceptable containment:
   a. Trays:

   b. Shipping container:

   c. Desiccator

d. Storage cabinets: should have containment built into them. If not, a tray should be added at least to the bottom of the cabinet to prevent a spill from leaking out.



e. Beaker:

f. Overpack: (putting a container fully inside another container is useful for reactive materials, highly toxic materials or for failing containers)

.

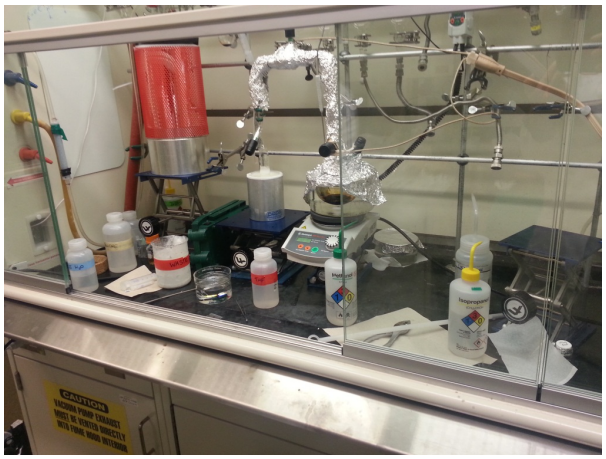
- Especially important for materials > 1 L, flammable, Highly toxic, volatile, air or water-reactive materials.

g. Refrigerators: make sure to keep incompatibles separate and leaks isolated.

2) *Active use of hazardous liquids*

a. Like to see containment if possible around reaction flasks, and reactive or toxic reagent bottles.

b. It is *not* expected around “squirt bottles”, which are in frequent use and therefore make it impractical.



c. It is good practice to have in work areas such as a fume hood.

d. Absorbent pads are also good and an option if working with < 1 L at a time and compatible with your material.

Non-hazardous Liquids

1) 5 gal or more of liquid should have a barrier to minimize chance of interacting with electrical strips and minimize water damage.

2) < 5 gal, containment is not necessary. However, containment can help to organize large numbers of very small containers and reduce labeling issues.

SOLIDS

Hazardous Solids

Hazardous solids in trays can help to segregate materials by common hazards.

Non-hazardous solids

Non-hazardous solids do not need containment.

RELEVANT SECTION OF *Prudent Practices in the Laboratory: Handling and Disposal of Chemicals.*

5.C.5 Storage of Chemicals

The accumulation of excess chemicals can be avoided by purchasing the minimum quantities necessary for a research project. All containers of chemicals should be labeled properly. Any special hazards should be indicated on the label. For certain classes of compounds (e.g., ethers as peroxide formers), the date the container was opened should be written on the label. Peroxide formers should have the test history and date of discard written on the label as well. Only small quantities (less than 1 liter (L)) of flammable liquids should be kept at workbenches. Larger quantities should be stored in approved storage cabinets. Quantities greater than 1 L should be stored in metal or break-resistant containers. Large containers (more than 1 L) should be stored below eye level on low shelves. Hazardous chemicals and waste should never be stored on the floor.

Refrigerators used for storage of flammable chemicals must be explosion-proof, laboratory-safe units. Materials placed in refrigerators should be clearly labeled with water-resistant labels. Storage trays or secondary containers should be used to minimize the distribution of material in the event a container should leak or break. It is good practice to retain the shipping can for such secondary containers.

All chemicals should be stored with attention to incompatibilities so that if containers break in an accident, reactive materials do not mix and react violently.

(See Chapter 4, section 4.E, and Chapter 7, section 7.C.1.2, for more information.)

Hood trays and other types of secondary containers should be used to contain inadvertent spills, and careful technique must be observed to minimize the potential for spills and releases.

All toxicity and emergency response information about the highly toxic chemicals being used should be readily available both before and during experimentation and should be located outside the immediate work area to ensure accessibility in emergencies. All laboratory workers who could potentially be exposed must be properly trained to participate in first aid or emergency response operations. In some cases the frequency with which highly toxic chemicals are used or the quantities involved might make formal emergency response drills warranted. Such "dry runs" may involve medical personnel as well as emergency cleanup crews.

(See also sections 5.C.11.5 and 5.C.11.6.)

5.D.7 Storage and Waste Disposal

Highly toxic chemicals should be stored in unbreakable secondary containers. If the materials are volatile or could react with moisture or air to form volatile toxic compounds, these secondary containers should be placed in a ventilated environment under negative pressure. All containers of highly toxic chemicals should be labeled clearly with chemical composition, known hazards, and warnings for handling. Chemicals that can combine to make highly toxic materials (e.g., acids and inorganic cyanides, which can generate hydrogen cyanide) should not be stored together in the same secondary container. A list of highly toxic compounds, their locations, and contingency plans for dealing with spills should be displayed prominently at any storage facility. Access to areas where highly toxic compounds are stored should be restricted to workers who are familiar with the risks they pose and who have been trained to handle these chemicals. Highly toxic chemicals that have a limited shelf life need to be tracked and monitored for deterioration in the storage facility. Those that require refrigeration should be stored in a ventilated refrigeration facility.

Reference:

Committee on Prudent Practices for Handling, Storage, and Disposal of Chemicals in Laboratories, National Research Council. "Working with Chemicals." *Prudent Practices in the Laboratory: Handling and Disposal of Chemicals*. Washington, DC: The National Academies Press, 1995.

Hazardous Waste

The Essential Information

1. Get the *Hazardous Waste Management Guidebook*.

Each lab should have a Hazardous Waste Guidebook. If your lab does not have one, or it has been misplaced, contact DEHS to obtain a new one. This book contains important information labs need to know in order to safely store and manifest hazardous waste. Or it can be found online at
http://www.dehs.umn.edu/hazwaste_chemwaste_umn_cwmgbk.htm
Use this book for more in-depth information than what is on this information sheet.

2. Complete the Hazardous Waste Online Training.

Every person in a group that is generating hazardous waste *must* complete **DEHS Chemical Waste Management Training** found online on the DEHS website and remember to record this training in Section 3 of the *LSO Guidebook*.

There should be one person in each lab group in charge of the hazardous waste. This does *not* have to be the LSO! This will help ensure all rules and regulations are followed by the group.

3. Label every container of waste.

HAZARDOUS WASTE

(final determination by Chemical Waste Program)

NAME: Brian Brosnan

START DATE: 8/6/2009 PHONE # 626-XXXX

FILL DATE: 8/25/2009

CONTENTS:

Water 50%

Acetic Acid 20%

Formic Acid 30%

pH = 3.0

check all **HAZARDS** that apply

☐ Flammable (07, 08, 09) ☐ Poison (18)

☒ Acid (02) ☐ Base (01) ☐ Oxidizer (16, 12)

☐ Low Hazard (05, 06)

Attach a label to waste container as soon as you start using it (found in the Chemistry Stockroom or contact DEHS), and record the start date. As chemicals are added to the collection bottle, add the names and quantities to the label. If the chemicals and mixtures you use can vary, you will need to maintain a ledger—kept next to the waste container—and then write the percentages of chemicals you have collected on the label at the time of the fill date.

4. Keep containers closed.

- Volatile chemicals can be released into the air, unnecessarily exposing personnel in the area or causing unnecessary air pollution to the environment.
- It is easy to knock over an open container and cause a spill affecting yourself and colleagues or resulting in a release to the environment.
- When you leave a container of flammable or reactive waste open, the chemicals are not protected from a source of ignition or a material that might react with it.
- With an open container, it is more likely that you may mix incompatible wastes together before thinking.

5. Use secondary containment.

When you collect or store liquid chemicals, use secondary containment. When you collect wastes, you are required to do so on surfaces that are impermeable to the waste. This means all waste should be collected where there are no drains, cracks or sumps through which the waste can transfer into the environment. In addition, certain wastes will attack common surfaces. For example, acids attack untreated concrete, and organic solvents compromise asphalt or flooring adhesives.

The best practice is to use containment trays for your waste, both for the collection containers and the filled containers or boxes awaiting collection. The rule of thumb for containment trays is to use one tray for each hazard class. Secondary containment trays are available from the University Stores.

6. Do not overfill containers.

Be sure to not overfill waste containers, especially liquid waste. A good rule of thumb is only to the shoulder of bottles or only the amount the bottle originally contained (i.e. only 4 Liters in a 4 L bottle). This is especially important because Hazmat employees will need to empty your waste container into larger bulk containers for transportation and disposal; overfilled bottles can make this difficult, risking spills and exposure of harmful chemicals to workers.

7. Segregate incompatible waste.

Use the drum designation code (DDC) to segregate incompatible chemicals in containers and boxes (see Appendix I). Generally, DDC numbers 05, 08 and 18 organic material can be stored together. Especially separate acids (02) from bases (01); oxidizers (16) away from organics (05, 18xx, 08); water away from any water sensitive compound (xxWS); cyanides (18CN) from acids (02); and organic acids (02OA) from oxidizing acids (nitric, fuming sulfuric, perchloric acids).

8. Packaging waste for disposal.

a. Check labels on containers

It is important to double-check labels as you prepare chemical waste for pick-up, since these labels can fade, become corroded, or have encountered spills that makes them difficult to read.

When preparing for pick-up, double-check that a label

- is clearly visible
- is fully legible
- contains all required information

b. Select the correct packing materials

All waste containers must be completely enclosed within sturdy cardboard boxes. Use appropriate cushioning or absorbent material to separate containers inside the boxes to insure that the containers do not slip during transit. Acceptable materials include:

- vermiculite (preferred choice)
- cardboard dividers
- crumpled newspaper

There are some exceptions to the cardboard box rule:

- Perchloric acid, fuming nitric acid, and fuming sulfuric acid are strong oxidizers, and will react with newspaper or cardboard if spilled. They should be packaged separately in a plastic bucket with a lid and surrounded by kitty litter, floor dry, or sand (30 pound bags of floor dry are available from University Stores).
- It is not necessary to place five-gallon pails of waste chemicals in cardboard boxes.
- Highly volatile chemicals that require refrigeration should not be boxed.

c. Segregate by hazard class

Just as when collecting waste, you must package waste containers based on hazard class. There must be only one hazard class per box/pail/bucket used to package hazardous waste containers. You determine a chemical's hazard class by using the Chemical Waste Registry. The registry, and how to use it, was covered in the Evaluate the Waste section of this tutorial.

d. General rules:

- When the box/pail/bucket is lifted, there should be no "clinking" sound heard between glass bottles.
- All bottles must be tightly capped and packed in an upright position.
- Waste containers should not be individually wrapped in paper.

e. Chemicals that require special handling.

- Unknown chemicals
- Refrigerated materials
- Compressed gas containers
- Waste containing chemical and radioactive materials
- Peroxide forming chemicals
- Pesticides
- Shock-sensitive chemicals
- Water-reactive chemicals
- Fuming Sulfuric acid
- Perchloric acid
- Fuming Nitric acid

Normal procedures for packaging these do not apply. If you are preparing any of these materials for disposal, you will need to refer to the Hazardous Waste Management Guidebook for exact procedures (you must contact DEHS prior to disposal).

f. Fill out the Waste Packing Form (consult the Guidebook *for more info).*

Waste packing forms can be found in the Chemistry Stockroom, requested at 612-626-1604 or hazwaste@umn.edu

Information needed to complete waste forms can be found at the on-line registry. Chemicals can be searched by name or CAS number and below in **Part 11. What do all the codes mean?** (p.41).

http://www.dehs.umn.edu/hazwaste_chemwastereg.htm

Unknown chemicals: if you are unsure of the compound or identity of the waste, please refer to Section 4, p. 38. All unknowns need to be packaged individually.

Chemical Mixtures:

1) List the mixture ingredients and their percentages on both the bottle label and waste packing form. (Include water as an ingredient of aqueous solutions). Enclose the mixture ingredients in brackets on the waste packing form (see form below).
2) Write the pH of aqueous solutions, or for organic liquids, the PH of an aqueous solution containing 10% of the organic mixture, on both the bottle label and waste packing form.
3) Indicate on the bottle label and waste packing form (underneath the compound name) the presence of any sludge, precipitate, or material that is polymerizable.
4) Package mixtures separately, in their own containers and boxes.

HAZARDOUS WASTE PACKING FORM WHITE–TRANSPORTATION COPY 014567

FEDERAL LAW PROHIBITS IMPROPER DISPOSAL. IF FOUND, CONTACT THE NEAREST POLICE, OR PUBLIC SAFETY AUTHORITY, OR THE U.S. ENVIRONMENTAL PROTECTION AGENCY

EPA GENERATOR SITE # MNT2800104 14

MINNEAPOLIS CAMPUS

CHEMICAL WASTE PROGRAM
DEPT. OF ENVIRONMENTAL HEALTH & SAFETY
UNIVERSITY OF MINNESOTA TWIN
501 23RD AVE SE, MPLS, MN 55455

CWP USE ONLY

☒ CARDBOARD BOX ☐ PLASTIC PAIL ☐ STEEL CAN

NAME Sonja Dahl GENERATOR TELEPHONE 626-6002

Date 10-25-96 Dept(1) 7655 BLDG#(1) 070 Room # W-140

DOOA (2)	CAS# (2)	COMPOUND NAME		EPA# (2)	RCRA? (1)	AMOUNT PER CONTAINER	DRUM# CWP USE
16SI	7761888A	Silver Nitrate	1%	D001	no	4.0 L	
05HM	20667123A	Silver Oxide	1%	D011			
16NA	7697372B	Nitric Acid	1%	D002			
00	7732185A	Water	97%	none			
		Same mixture as above, pH=1				4.0 L	

pH=1

THIS IS TO CERTIFY THAT THE ABOVE NAMED ARTICLES ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED AND LABELED AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATIONS OF THE DEPARTMENT OF TRANSPORTATION. MISDESCRIPTION CONSTITUTES VIOLATION OF FEDERAL LAW (PUBLIC LAW 93-633). THIS COULD RESULT IN CIVIL OR CRIMINAL PENALTIES. BY MY SIGNATURE BELOW, I FURTHER CERTIFY THAT I HAVE READ AND FULLY UNDERSTAND THE GUIDELINES GIVEN TO THE UNIVERSITY OF MINNESOTA AS REGARDS CHEMICAL WASTE DISPOSAL AS EMBODIED IN THE GUIDEBOOK AND HAVE FOLLOWED APPLICABLE PROCEDURES DESCRIBED THEREIN.

Required Signature Sonja Dahl Date 10-25-96

9. Dispose hazardous waste before 90 days.

- *For Chemistry:* Drop-off in S43 Smith 1–3pm every Wednesday
- *For CEMS:* Pick-up only

After packaging the hazardous waste and filling out the packing forms:

a. Remove the pink copy off of all the packing forms and tape them onto the top of the box.

b. Staple all the packing forms from a box together and mail them to:

CHEMICAL WASTE PROGRAM
DEPT. OF ENVIRONMENTAL HEALTH AND SAFETY
UNIVERSITY OF MINNESOTA TCEM
501 23RD AVE SE, MPLS, MN 55455
Campus Mail: TCEM 2681

- The envelope doesn't need a stamp if you send it by campus mail
- There is a campus mail drop box by the west end entrance to Amundson Hall

c. Leave the box near the door of the lab and it will be picked up in ~1-2 weeks

10. Where does it go?

All the hazardous waste generated at the University is first brought to the Thompson Center for Environmental Management, located at the east end of the Minneapolis area of the Twin Cities Campus. The Center is a state of the art facility for managing hazardous wastes; the premier academic facility in the nation. At the center, wastes are stored for re-distribution, processed for recovery of usable or valuable materials, or repackaged for shipment to disposal facilities for proper disposal. Some wastes are blended with fuel for energy recovery, others are incinerated in well-designed off-site incinerators, and others are specially treated to neutralize the hazardous components. Very few chemicals are sent for burial in the land.

11. What do all the codes mean?

Drum Designator Code (DDC)

The DDC is a two-part system developed by the University of Minnesota to classify hazardous wastes. The first two digits identify the hazard class (DOT) and the second two digits the University's internal waste management codes.

Substances are given a hazard class designation, and assigned a management method. You will use a chemical's DDC number to identify its hazard class(es). You need to identify hazard classes to correctly segregate incompatible materials when you collect, store, and pack your chemical waste for disposal. You will also need to provide a chemical's DDC number when filling out the form to have your hazardous waste picked-up.

DOT Hazard Class Codes

The first two digits of the DDC are adapted from the Department of Transportation's hazard class codes. You use the first two digits of the DDC system to identify hazard classes. You need to identify hazard classes to correctly segregate incompatible materials when you collect, store, and pack your chemical waste for disposal. The hazard codes are:

01	Corrosive bases	09	Flammable solids
02	Corrosive acids	11	Non-flammable gases
05	Other hazardous materials	12	Organic peroxides
06	Combustible materials	14	Explosives
07	Flammable gases	16	Oxidizers
08	Flammable liquids	18	Poisons

University Management Codes

The second two digits of the DDC are the University's internal waste management codes. Primarily, you will use the University management codes when filling out the waste disposal form. This step will be discussed in the Fill Out Form section of this tutorial. However, the management codes can also provide you some useful information (such as whether a chemical is explosive, or non-hazardous).

NH	Non-hazardous	BS	Bulkable solvent
CG	Compressed gas	PA	Poison A
CL	Chlorinated organic liquid	PB	Poison B
CN	Cyanide	PI	Poisonous inorganic
CS	Chlorinated organic solid	PO	Pourable oil
DX	Dioxin containing	PX	PCB contaminated
EX	Explosive	RX	Radioactive material
FB	Fuel Blending	SC	Sulfuric acid/chromerge
HM	Heavy metal	SI	Solid inorganic
HP	Pesticide	SO	Solid inorganic
LI	Liquid inorganic	SS	Shock sensitive
LO	Liquid organic	TW	Trade Waste Incinerator
NA	Nitric Acid	WS	Water Sensitive

Environmental Protection Agency (EPA) hazardous waste number

The EPA hazardous waste number is an alternate system for classifying hazardous wastes. You will not use this number in the general management of your waste. However, you will need to provide a chemical's EPA hazardous waste number when you fill out the form to have your hazardous waste picked-up. The EPA hazardous waste system is:

D001	Ignitable Characteristic - flammable liquids and oxidizers
D002	Corrosive Characteristic
D003	Reactive Characteristic - water and shock sensitive compounds
D004–D043	Toxic Characteristic materials - heavy metal poisons and specific pesticides
Pxxx	EPA listed acutely hazardous wastes
Uxxx	EPA listed toxic hazardous wastes

Toxic materials not specified by EPA list, but meet Minnesota Toxic Characteristic standards.

MN01	Lethality Characteristic
MN03	Polychlorinated biphenyls

Chemical Abstract Service (CAS) Number

The CAS number is a unique number assigned to a chemical compound. You can also find this number in a chemical's Material Safety Data Sheet (MSDS). You will need to know a chemical's CAS number when you fill out the form to have your hazardous waste picked-up. This will be discussed in the Fill Out Form section of this tutorial.

Note: If you have chemicals that are difficult to evaluate (e.g., certain mixtures, and chemicals not in the Chemical Waste Registry), you will also need to contact DEHS before you package them for pick-up.

References:

(1) DEHS Chemical Waste Management Online Training

(2) DEHS Hazardous Chemical Waste Management Guidebook

(3) http://www.dehs.umn.edu/hazwaste_chemwaste.htm

Common Hazardous Waste Violations

The University of Minnesota is regularly inspected by the following agencies:

- Metropolitan Counties
- Minnesota Pollution Control Agency
- Environmental Protection Agency

The following list shows which violations are most commonly cited by regulators. Please review this information and correct any problems in your area. Failure to periodically review your compliance efforts can cause health and safety concerns as well as fines from city, county, state or federal inspectors. Fines are the responsibility of the department that incurs them.

Problem	Fine	Solution
Labeled improperly	$325	Waste containers must have: • the words "Hazardous Waste" on them • complete description of the waste. • the start date. • the fill date, when filled. Note: Labels with the proper wording are available at no charge from the Chemical Waste Program hazwaste@umn.edu or (612) 624-6060 or you may make a facsimile of the label (see Figure 4-2).
Containers not closed	$675	Keep containers closed except when adding or removing waste.
Incompatible wastes/chemicals stored together	$825	Separate waste containers and reagent chemicals by the first two digits of the drum designation codes (DDC number) (see Appendix I), per the instructions above.
Waste not contained properly	$475	Containers of liquid waste need secondary containment. Bottles of waste should be kept in chemical storage cabinets or in chemically resistant trays (University Stores, catalog no. CX18999), and separated by hazard class (DDC number) (see Appendix I).
Lab personnel not aware of proper response in event of chemical spill, fire, explosion, or injury	$825	Train your employees and students in emergency procedures. Follow procedures in this Guidebook and in your Chemical Hygiene Plan. For chemical spill response assistance in the Twin Cities metro area, call EHS at (612) 626-6002 during work hours or call 911 for 24-hour assistance.
Chemicals disposed of improperly	$825	1. Do not sewer chemicals without approval of Chemical Waste Program. 2. Do not evaporate residual solvents in fumehoods. Use condensers on all distillation and concentration procedures. 3. Do not throw hazardous waste in trash.
Waste not compatible with hazardous waste storage container used	$825	Use containers and lids or caps that are compatible with the waste stored in them.
Personnel not properly trained	$825	Employees and students must be trained prior to working with chemicals and must receive annual refresher training. Training options are outlined above. All personnel working with hazardous chemicals must review this Guidebook. Call (612) 624-6060 for hard copies or visit our web site at http://www.dehs.umn.edu Document training and file documentation in your departmental head office. Sample training documentation forms are included in this Guidebook (Appendix II). Review the requirements of your Chemical Hygiene Plan. Call (612) 626-2330 for a copy of the University's generic Lab Safety Plan.

Disposing of Unknown Chemical Waste

Before disposing of laboratory waste, its hazard class must be identified so that it can be transported and disposed of safely and in accordance with regulatory standards. For this reason, and for safety considerations of everyone working in the laboratory, do not allow containers of unknown chemicals to accumulate. Avoid generating materials of unknown composition by properly labeling bottles and boxes with the contents, its associated hazards, and the date the waste chemical was first added to the container. If required, inspect the condition of the containers and their labels weekly, documenting the inspections. If a label appears faded or illegible, affix a new label to the bottle.

In the event you are unsure of the exact contents of a chemical mixture or you have an unlabeled compound, you can assist the Chemical Waste Program in the analysis of the unknown item by examining the container and the contents and making some initial observations. Photocopy the Unknown Preliminary Analysis Checklist (found at http://www.dehs.umn.edu/PDFs/formd.pdf) and complete the form, recording your observations and any known history of the material as requested.

Retain one copy of the completed form and submit a second copy to the Chemical Waste Program at the following address:

CAMPUS MAIL
Chemical Waste Program
Dept. of Env. Health & Safety
TCEM

US MAIL
Chemical Waste Program
University of Minnesota
TCEM-Thompson Center for
Environmental Management
501- 23rd Avenue SE
Minneapolis, MN 55455-0447

Or fax to: (612) 626-1571

Once the Chemical Waste Program receives the Unknown Analysis Checklist, it will be reviewed and a technician will be dispatched to your laboratory to analyze the unknown using a series of chemical tests. The technician will need to use a fumehood for these tests. If you have not been contacted by chemical waste personnel nor had your waste evaluated in two to three weeks, contact the Chemical Waste Program at (612) 626-1604.

CAUTION: Wear appropriate protective clothing and work in a hood when opening containers of unknown chemicals. Keep in mind the hazards involved in handling potential pyrophoric and peroxide forming chemicals. Several classes of chemicals can form explosive peroxides on long exposure to air. Unless it is known that the compound does not contain an explosive substance, do not use heroic efforts to open the bottle to examine the contents; it may be necessary to dispose of the bottle as a potentially explosive chemical. If you have questions concerning potential explosives, contact the Chemical Waste Program at (612) 626-1604.

Disposing of Old Equipment and Electronics

Disposal of electronics is regulated by law. Unwanted electronics (e-waste) containing printed circuit boards and/or cathode ray tubes, (e.g., computer monitors), are considered hazardous waste by the state of Minnesota if not managed for recycling, reuse, reclamation, or demanufacture.

E-waste can be accumulated up to one year and must be properly labeled "Used Electronics - For Recycling" with the accumulation date (date that the item was designated as unwanted). Each item or container of items must be labeled.

It may surprise you to know that the following items are all considered hazardous electronic waste when no longer wanted:

1. Computer monitors and computers
2. Computer keyboards, mice, etc
3. Printers, scanners & photocopiers
4. Circuit Boards
5. Televisions
6. Fax machines
7. Electric typewriters
8. Calculators
9. Laboratory equipment
10. Video monitors
11. Telephones & telecommunications equipment
12. Audio Equipment

Your Options

So, what can you do to get rid of your old equipment? The following options are available through the University of Minnesota:

- The Office of Information Technology (OIT) http://oit.umn.edu/computer-recycling has contracts in place to pick up your computer products, CPU, monitor, keyboard, mouse, and other hardware free of charge. Contact Asset Recovery Corp at (651) 602-0789 to schedule a departmental computer equipment pickup. U of M departments are still responsible for sanitizing all computer items that may contain data (e.g. hard drives, thumb drives) before the vendor picks them up for recycling.
- The University Recycling Program (612-625-6481) will arrange to collect non-computer electronic waste and is free of charge. They maintain a Reuse Program/Virtual Warehouse at http://www1.umn.edu/reuse/index.html to distribute non-computer electronics and other items back into the University community; call them to have pictures of your equipment posted to the Web. Electronics not suitable for use are sent to the University's electronics recycling contractor. They will also collect "mixed loads" containing both computer and non-computer electronics.

Regardless of what option you employ to get rid of your e-waste, shipments must be accompanied by a shipping paper, bill of lading, or manifest. The shipping documents must include the name of shipper, the date of shipment, the amount of waste, and the destination facility's name, address and phone number. Records must be kept for all shipments of e-waste. Each copy must be maintained on site for a period of three years from the date the shipment was initiated.

What is a Safety Moment?

A safety moment is a short (2-5 min) presentation or discussion of a safety topic. These should be offered at the beginning of group or departmental events as an effort to bring safety to the forefront of everyone's mind.

Group Meetings:

Lab safety officers should implement a safety moment at the beginning of each group meeting. Any group member can give the safety moment and the recommended method of delivery is Powerpoint and/or discussion. These topics can be tailored to address hazards encountered in your lab specifically. Ask your PI for permission in advance so you have their support from the beginning.

Content can be found at www.jst.umn.edu in the form of a list of potential topics and a database of safety moments. If you have other ideas for this topic list or have safety moments to contribute to the database, please email them to jst@umn.edu. Alternatively, content can be acquired through DEHS (www.dehs.umn.edu), learning experience reports (LERs), research safety blogs, or an internet search.

Examples:

- Presentation of pictures showing either safe or unsafe procedures – discuss what makes these scenarios safe or unsafe.
- Short video of a safety incident – could be a demonstration of a procedure or related to safety in a different way, such as awareness.
    - Consider reports from other universities or industries
- Discuss an unsafe procedure that was witnessed in the past week – discuss how this could be avoided or made safe.
    - It might help to start with something you did yourself – if you had a small spill earlier in the week, discuss how you have adjusted your procedure to reduce the risk
- Poll group members during the week asking what hazards they would like to learn more about, then present some relevant information on that topic
- Ask PI to give an example/ story of a safety incident that occurred when they were in grad school
- Introduce resources – explain DEHS website, stockroom PPE availability, SOPs, glass shop, etc.
- Lab members showcase their common reactions, hazards, and emergency response procedures
- Brainstorm worst-case scenarios and responses for a new reaction or setup
- Describe emergency exit procedures (how to get out of building, where to go, etc.)
- Discuss a recent safety success (100% lab coat compliance, good audit results, etc.)
- Reminders for proper PPE usage (wear lab coats, no gloves in the hall, etc.)

Seminars:

The departmental seminar coordinator should arrange for the presentation of at least one safety moment at the departmental seminar each week. This short presentation (< 3 min) should be given at the start of the seminar, prior to the speaker's talk. Content for these safety moments should focus on more general safety concerns as they will address a broad audience or address a specific safety issue related to research of the invited speaker. The speaker host is the best person to give these moments via Powerpoint. Care should be taken to present new topics (so the same topic is not used multiple times per semester) to increase their effectiveness.

For content ideas visit www.jst.umn.edu to view a list of potential topics and a database of safety moments. Also see the Group Meeting section above for examples.

Electrical Safety

The typical laboratory contains a wide variety of electrically powered equipment including computers, stirrers, shakers, pumps, hot plates, heaters, and power supplies. Many laboratory electrical devices have high voltage requirements that elevate the risks associated with their use. The major hazards associated with electricity are electrical shock and fire. All electrical devices used in the lab setting present a potential danger of injury if improperly used or poorly installed and/or maintained.

General guidelines for electrical Safety

- Do Not use extension cords as permanent power source.
- Replace defective cords and plugs. Consistently inspect cords for defects including cracked insulation, frayed wiring, and loose connection.
- Never overload a circuit.
- Never place containers of liquid on electrical systems.
- Turn off the power and unplug equipment before performing any maintenance on the equipment.
- Always check the electrical rating of the equipment and use within this rating.
- Never install a fuse of higher amperage than is specified for the equipment.
- Do not work on electrical equipment in a wet area or when touching an object that could provide a hazardous grounding path.

Questions regarding operation, maintenance, or safety of electrical equipment or electronics should be directed to the lab safety officer or an appropriate expert.

Hazard: Electrical Shock

Electrical shock occurs when the body becomes part of the electric circuit, either when an individual comes in contact with both wires of an electrical circuit, one wire of an energized circuit and the ground, or a metallic part that has become energized by contact with an electrical conductor. The severity and effects of an electrical shock depend on a number of factors, such as the pathway through the body, the amount of current, the length of time of the exposure, and whether the skin is wet or dry. The effect of the shock may range from a slight tingle to severe burns to cardiac arrest. Currents only slightly in excess of one's let-go current (the current at which a person is frozen to the circuit and unable to let go) are said to “freeze” the victim to the circuit. Prolonged exposure to currents only slightly in excess of a person’s let - go limit may produce exhaustion, asphyxia, collapse, and unconsciousness followed by death.

Action: When someone suffers serious electrical shock, he or she may be knocked unconscious. If the victim is still in contact with the electrical current, immediately turn off the electrical power source. If you cannot disconnect the power source, try to separate the victim from the power source with a nonconductive object, such as a wood-handled broom.

IMPORTANT:

Do not touch a victim that is still in contact with a power source; you could electrocute yourself. Have someone call for emergency medical assistance immediately (911). Administer first-aid, as appropriate.

Hazard: Electrical Fire

Electrical fires are caused by a variety of sources including electrical system failures, incorrectly installed wiring, and overloaded circuits and extension cords. In addition, sparks from electrical equipment can serve as an ignition source for flammable or explosive vapors or combustible materials.

Action: If an electrical fire occurs try to disconnect the electrical power source, but only if you can do it without endangering yourself. If the fire is small, you are not in immediate danger, and you have been trained in fighting fires, use any type of fire extinguisher except water to extinguish the fire.

Preventing Electrical Hazards

There are various ways of protecting people from the hazards caused by electricity including insulation, guarding, grounding, and electrical protective devices. Laboratory workers can significantly reduce electrical hazards by following some basic precautions:

- Inspect laboratory electrical equipment and cords to be sure they are in good condition. Remove equipment from service if in poor condition and replace or have it repaired by an authorized and qualified repair person.
- Use safe work practices every time electrical equipment is used.
- Know the location of your electrical panels and shut-off switches so you can quickly disconnect power in the event of an emergency. Be sure to always leave at least a 3-foot clearance around electrical panels for easy access.
- Minimize the potential for water or chemical spills on or near electrical equipment.
- Plan ahead for what steps will be taken in the event of a power loss. Think about potential vapor/gas release from vapor-generating processes or chemical fume hoods if power is lost.

Power Cords and Insulation

All electrical cords should have sufficient insulation to prevent direct contact with wires. In a laboratory, it is particularly important to check all cords before each use, since corrosive chemicals or solvents may erode the insulation.

Damaged cords should be repaired or taken out of service immediately, especially in wet environments such as cold rooms and near water baths.

- Inspect power cords to be sure they are not frayed or have exposed wiring.
- Electrical tape is not an acceptable repair for a damaged cord; replace the entire cord.
- Carefully place power cords so they don't come in contact with water or chemicals. Contact with water is a shock hazard. Corrosives and solvents can degrade the cord insulation.
- Do not allow cords to dangle from counters or hoods in such a manner that equipment could be unplugged, fall, or cords could be tripped over.
- Do not allow cords to contact hot surfaces to prevent melting insulation.
- Do not lift a piece of electrical equipment by the cord or pull the cord to disconnect from the outlet in order to prevent damage.
- Power cords must have grounding plugs or be double insulated.
- Extension cords are for temporary use only for short periods of time. The only exception is that electrical power strips (UL Approved) are allowed only for personal computers and their components. In all other cases, request installation of a new electrical outlet.
- Multi-plug adapters are for temporary use only for short periods of time and must have circuit breakers or fuses. Multiple plug outlet adapters are not allowed for long periods of service. For permanent applications, request installation of an additional electrical outlet.

Circuit Protection

Circuit protection devices are designed to automatically shut off the flow of electricity in the event of a ground-fault, overload or short circuit in the wiring system. Ground-fault circuit interrupters, circuit breakers and fuses are three well-known examples of such devices.

- No more than two high current draw devices such as ovens and centrifuges should be plugged into the same outlet to prevent an overloaded circuit. Overloading can lead to overheated wires and arcing. This can cause electrical shock injury and fire.
- Fuses and circuit breakers prevent over-heating of wires and other electrical components. This overload protection is useful for equipment that may be left on for a long time such as stirrers, drying ovens, vacuum pumps, Variacs, etc.
- Ground-fault circuit interrupters, or GFCIs, shut off the electrical current if a ground-fault is detected and protect the user from electric shock. GFCI outlets or portable GFCIs are used near sinks and potentially wet locations. Keep electrical equipment (and yourself while you are using electrical equipment) away from water/chemical or their spills unless you are sure the equipment is rated for this type of use. Since GFCIs can cause equipment to shutdown unexpectedly, they may not be appropriate for certain apparatus. Portable GFCI adapters (available in most safety supply catalogs) may be used with a non-GFCI outlet.

Grounding

Only equipment with three-prong plugs should be used in the laboratory. The third prong provides a path to ground for internal electrical short circuits, thereby protecting the user from a potential electrical shock.

- Electrical appliances are grounded through the electrical receptacles.
- Electrical outlet receptacles must have a grounding connection and accept three-prong plugs.
- Grounds to prevent static load and/or discharge should be grounded to a grounding terminal and not to the ground of an electrical receptacle.

Shielding and Equipment Guarding

Exposed, un-insulated electric components provide a source of electrical shock.

- Equipment operating at 50 volts or more (i.e., electrophoresis devices) must be guarded against accidental contact.
- Plexiglas shields may be used to protect against exposed live electrical circuits and parts.
- Shields may be removed for service only after the equipment has been de-energized.

Power Supplies

Portable power supplies are commonly used in the laboratory. These devices are extremely high electrical energy sources and must be used carefully.

- Power supplies should be shielded and grounded.
- Power supplies and electronic equipment used with aquariums and open water tanks, tubs, and containers must be positioned away from the tanks so that they will not fall into the water and electrical circuits must be equipped with GFCI type breakers.
- Use only approved connectors. Never attach an exposed connector such as an alligator clip to a power supply.

Flammable and Combustible Materials

Electrical devices, plugs, cords, and other equipment can provide a source of ignition sufficient to ignite combustibles and flammable or explosive vapors.

- Keep flammable materials away from electrical equipment.
- Do not store flammable organic liquids above electrical devices.
- Extension cords, power strips, and power cords located on the floor can provide a source of ignition in the event of a flammable liquid spill. Position these items carefully.
- Receptacles providing power for equipment used inside a fume hood should be located outside the hood.
- Make sure that equipment used where flammable vapors may be present is specially rated to not produce sparks. Many household appliances such as hot plates, vacuum cleaners, and drills don't meet this requirement so they should be used only under very controlled conditions.
- If refrigeration or freezing is needed, flammable materials should only be stored in laboratory safe flammable refrigerators or explosion proof equipment. These do not contain any ignition sources such as lights and switches.
- Do not plug heating mantles directly into a 110-volt outlet as they can overheat, leading to fire hazard. They need a variable autotransformer to control the input voltage.
- Be aware that if drying ovens are used to dry organic materials that they or their vapors may accumulate inside the oven and ignite or escape into the lab atmosphere. Take care to prevent developing explosive mixtures in air by using the ovens properly, not packing them too full or not drying organic materials that can create these conditions.

Power Loss

Be prepared for a power loss. The loss of electrical power can create hazardous situations.

- Flammable or toxic vapors may be released as chemicals warm when a refrigerator or freezer fails.
- Fume hoods may cease to operate allowing vapors to accumulate or be released into the laboratory.
- Magnetic or mechanical stirrers that fail to operate may compromise safe mixing of reagents.

High Voltage Equipment

Repairs of commercial high voltage equipment can only be performed by trained electricians. Laboratory workers who are authorized and experienced to perform such work on their own laboratory equipment must first receive specialized electrical training and electrical safety training in safe work practice controls.

High Voltage Safety Requirements:

1. Shielding: Live parts of all electrical equipment must be completely enclosed or otherwise guarded against accidental contact.
2. Interlocking: Where continual maintenance or adjustments must be performed, enclosing shields must be provided with interlocks which will disconnect all power to conductors and short out capacitors when the shield is removed or opened.
3. Disconnects: Provide an accessible, labeled main power disconnect switch.

4. Grounding: Ground all exposed non-current carrying parts. (Metallic table tops should be grounded to a grounding terminal.)

5. Bonding: All grounded parts must be bonded to each other to keep them at the same grounded electrical potential.

6. Insulators: Adjustment mechanisms must be insulated from live electrical parts or be made of nonconductive material.

7. Space: A minimum of 30 inches width should be maintained on all working sides of equipment operating at 600 volts or less; 36 inches if over 600 volts.

8. Floors: Regard all floors used in high voltage applications as conductive and grounded unless covered with well maintained dry rubber matting suitable for electrical work.

9. Working Alone: Working alone at any time is not allowed.

10. CPR: It is recommended that all persons working with lasers have training in cardiopulmonary resuscitation, available through the EH&S, Risk Management, or through the American Red Cross.

Safe Work Practices

Safe work practices are an administrative hazard control used to prevent injury and accidents. The following safe work practices will reduce risk of injury or fire when working with electrical equipment. Personnel must understand and be trained to practice the following procedures:

1. Avoid contact with energized electrical circuits.

2. Treat all electrical devices as if they are live or energized.

3. Disconnect the power source before servicing or repairing electrical equipment.

4. Use only tools and equipment with non-conducting handles when working on electrical devices.

5. Never use metallic pencils or rulers, or wear rings or metal watchbands when working with electrical equipment.

6. When it is necessary to handle equipment that is plugged in, be sure hands are dry and, when possible, wear nonconductive gloves and shoes with insulated soles.

7. If it is safe to do so, work with only one hand, keeping the other hand at your side or in your pocket, away from all conductive material. This precaution reduces the likelihood of accidents that result in current passing through the chest cavity.

8. Minimize the use of electrical equipment in cold rooms or other areas where condensation is likely. If equipment must be used in such areas, mount the equipment on a wall or vertical panel.

9. If water or a chemical is spilled onto equipment, shut off power at the main switch or circuit breaker and unplug the equipment.

10. If an individual comes in contact with a live electrical conductor, do not touch the equipment, cord or person. Disconnect the power source from the circuit breaker or pull out the plug using a leather belt.

11. Equipment producing a "tingle" should be disconnected and reported promptly for repair.

12. “Shorts” (ground faults) are extremely hazardous especially where in contact with metal frame-work of an exhaust hood or damp floor.

13. Do not rely on grounding to mask a defective circuit nor attempt to correct a fault by insertion of another fuse or breaker, particularly one of larger capacity.

14. Keep use and length of extension cords to a minimum.

15. Never work on live equipment.

16. Drain capacitors before working near them and keep the short circuit on the terminals during the work to prevent electrical shock.

17. Never touch another person's equipment or electrical control devices unless instructed to do so.

18. Enclose all electric contacts and conductors so that no one can accidentally come into contact with them.

19. Never handle electrical equipment when hands, feet, or body are wet or perspiring, or when standing on a wet floor.

20. Whenever possible, use only one hand when working on circuits or control devices.

21. When it is necessary to touch electrical equipment (for example, when checking for overheated motors), use the back of the hand. Thus, if accidental shock were to cause muscular contraction, you would not "freeze" to the conductor.

22. Do not store highly flammable liquids near electrical equipment.

23. Be aware that interlocks on equipment disconnect the high voltage source when a cabinet door is open but power for control circuits may remain on.

24. De-energize open experimental circuits and equipment to be left unattended.

25. Unplug cords by gripping the plug end; do not pull on the cord.

26. Do not wear loose clothing or ties near equipment.

References:

(1) Prudent Practices in the Laboratory – Handling and Disposal of Chemicals, National Research Council, National Academy Press, Washington, D.C., 1995.

(2) CRC Handbook of Laboratory Safety, CRC Press, Washington DC, 2000.

(3) Indiana University Laboratory Safety Guideline. Electrical Safety. By: Christopher Kohler.

Ergonomics in the Office

Highly forceful or repetitive motions using awkward postures can result in discomfort, disabling injuries. As a result, the departments of Environmental Health and Safety and Risk Management, Purchasing, AFSME and U Return are working together to reduce the likelihood of such injury among University employees.

Getting a workstation evaluation or training in ergonomic practices can greatly reduce your chance of injury.

The following resources are available to University employees:

Free Workstation Self Assessment and Evaluation

Complete the "Office Ergonomics Assessment" (found at http://www.dehs.umn.edu/ergo_office_guide.htm) to self-correct ergonomic problems. The self-assessment tool contains contact information if additional assistance is needed to properly set up a workstation. Allow 4 weeks to schedule an evaluation. Access to this site requires a University of Minnesota x.500 ID and Password. Upon completion of this assessment, University employees will have a record of its completion placed into their PeopleSoft Training Records.

To Purchase Chairs and Other Equipment

University of Minnesota discounts are available through the vendors featured on this site. Please contact vendors directly to purchase chairs or any of the other products listed; you'll find their contact information under each product description. Contact Jerry Taintor in Purchasing at (612) 624-5762 if you encounter any problems with vendors.

Employee Assistance Program

http://www.umn.edu/ohr/eap/
Civil service & bargaining unit staff, call (612) 626-0253. Faculty and Academic Staff Assistance Program, call (612) 625-4073.

Training

Training for employees or supervisors on office ergonomics is available free of charge. Handouts and videotapes are available. Contact Neil at (612) 626-5714 or carls001@umn.edu for further assistance.

Laptop Ergonomics

Today, many computer users have turned to convenient portable laptops as either an adjunct to their workstations, or as an alternative to a desktop computer. Just as desktop computers have specific guidelines and recommendations for safe and healthy use, so do laptops. The following is a list of things to consider and try to promote and ensure comfort when using them.

Laptop Typing Guidelines

- Set up the laptop keyboard, much like you would your regular keyboard. Elbows should be level with or slightly higher than the keyboard (elbows at approximately 90 degrees, wrists level, upper arms hanging as vertically as possible).
- Try using a chair that does not have arm rests so that you will have room to move your arms.
- If you have the option to plug in your regular keyboard and monitor to your laptop, do so.
- The laptop can also be used as a monitor while using a separate keyboard and mouse placed on the desk or on a keyboard.
- If not, avoid resting on the wrist rest areas WHILE typing. Try using whole hand and arm movements to navigate around the keys.
- If you are unfamiliar with your laptop keyboard, try watching your hands at first to learn where all the keys are placed. Some of them may have been rearranged.
- As the touch on laptops are often lighter, and the key bed is shallow, be especially careful not to pound on the keys.

- If your laptop has a glide point that is difficult to move, try plugging in an external mouse, and / or try using key commands instead.
- When looking down at the screen, be careful not to bend your neck and head forward to see. Try tucking in your chin to look down, keeping your head and neck more or less balanced over the spine.

Guidelines for using laptops "on the go"

- When traveling, make sure to set yourself up as ergonomically as possible. If you are in a hotel, conference room, or any other facility, don't settle for resting your laptop on a desk, table, counter, or surface that is high or far from reach. Your options include:
    - Using a pillow, pad or even folded towels, to raise your chair high enough so that your elbows are level or slightly higher than the keyboard (elbows at approximately 90 degrees).
    - Using a pillow, pad or even folded towels, to raise your chair high enough so that your elbows are level or slightly higher than the keyboard (elbows at approximately 90 degrees).
    - Asking if the hotel has a docking station for laptops. If not, ask if there are computer workstations for desktops (many hotels are computer user friendly) and plug into their keyboard and monitor.
- If you can't find a surface low enough, or a chair high enough, then your lap is always an option.
    - Sit so that your knees and hips are level. This will allow the laptop to rest comfortably on your lap.
    - Again, be careful with your neck. Look down at the screen by tucking your chin in as opposed to bending your entire neck down, as this can cause strain and fatigue to the neck and shoulder area.
    - Try using a chair that does not have armrests to give you room to move your arms.
    - If the seat is too deep add a pillow for back support.
- If you elect to place your computer on the food tray, and it is too high to achieve comfort, try raising your seat height by folding one or two blankets under you. If that doesn't work, you may be best off using your lap. This strategy may reduce circulation around the laptop and allow it to heat up. Placing a hard surface between the laptop and the shallow pillow can help.

Transportation

- Laptops are often heavy which means you should avoid carrying them with a handle. Try carrying them on your shoulder and use a bag with a padded shoulder strap.
- Consider the weight of the laptop when purchasing.

Pace Yourself

- Pace yourself. Take frequent breaks. Stand up and stretch. If you feel any strains or pains, stop what you are doing and experiment with different positions. The same rules of healthy computer use applies to laptops as well as desktops.

Authors: Vivienne Griffin and Norman J. Kahan, M.D., Cupertino, California Additional information provided by Neil Carlson, DEHS

References:

(1) DEHS Ergonomics: http://www.dehs.umn.edu/ergo.htm
(2) http://www.dehs.umn.edu/ergo_office_laptop.htm

Ergonomics in the Lab

Highly forceful or repetitive motions using awkward postures can result in discomfort and disabiling injuries. Many people assume ergonomic risks only apply to office work, but there can be significant ergonomic risks present during computational and wet lab research. Basic ergonomic principles, self-assessment tools, and employee assistance information can be found at the DEHS website (http://www.dehs.umn.edu/ergo.htm).

Pipetting

This laboratory procedure is highly repetitive and involves a variety of risk factors. Cumulative Trauma Disorders (CTD) or MSDs may occur when a laboratory worker pipettes for two hours a day or longer on a continuous basis.

Associated Risk Factors:

- Repetitive motion of the hands, forearm and thumb, or fingers
- Pinch grip when handling pipette tips, or opening vials
- Bending and twisting of the wrist
- Working with "winged" elbows (elbow held at an elevated position away from the body)
- Neck bent forward or to the side and/or jutted chin
- Awkward and static postures
- Excessive force of the thumb
- Overreaching
- Standing for long periods of time

Preventive Measures:

Work Smart, eliminate/reduce the impact of laboratory ergonomic stressors.

- Perform your work only at appropriate heights.
- Alter continuous repetitive pipetting by performing other tasks, or take frequent small rest breaks every 20 minutes.
- Be sure to work with wrists in neutral positions (straight).
- Adjust height and position of sample holders, solution container, waste receptacle to prevent twisting and bending of wrist, neck and rolled shoulders.
- Reduce shoulder strain, avoid working with winged elbows/arms.
- Use short pipettes, shorter waste receptacles for used tips, to reduce reaching.
- Use electronic pipettes for highly repetitive pipetting tasks to reduce/eliminate contact pressure on thumb.
- Ensure proper lower back and thigh support, by using adjustable stools or chairs with built-in foot and armrest.
- Avoid standing for long periods. If standing is unavoidable, use Anti-Fatigue Mats.
- Work at appropriate heights to minimize twisting of the neck and torso.
- Replace manually operated pipettes with electronic ones for larger workloads.
- Make sure head and shoulders are kept in neutral position.
- Avoid elevating arms and elbows above shoulder for lengthy periods to prevent static work of arm, and shoulder strain
- Task sharing is another way to reduce the impact of risk factor associated with pipetting.

Fumehoods/ Biological Safety Cabinets

Working in Biological Safety Cabinet (BSC's) or fumehoods requires laboratory personnel to assume a variety of awkward postures due to limited work access, which restrict arm movement, and therefore significantly increase the amount of stress on joints of the upper limbs, neck, and back.

Associated Risk Factors:

- Repetitive motions of the hands, wrist, and forearms, especially when pipetting is involved
- Constrained knee and leg space, especially in fume hoods and older BSCs
- Contact pressure on the forearms, wrists and knees, or legs
- Awkward and static posture of the neck, torso, legs, arms and wrists
- Constrained body position, overloading muscles, tendons, and joints in asymmetrical manner
- Working with elbows winged
- Overreaching
- Prolonged standing in unnatural positions or in restricted postures

Preventive Measures:

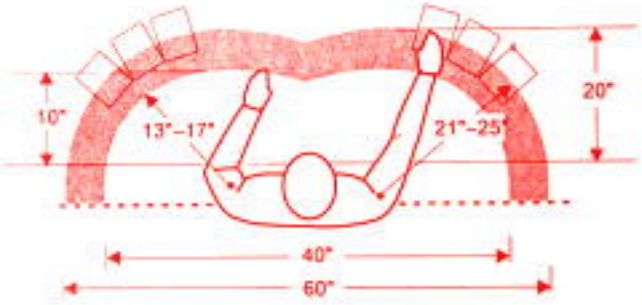
- Prevent extended reaching, place materials as close as possible
- Perform your work at least six inches back into the hood or BSC to maintain optimal airflow containment for material and personal protection.
- Always assume a proper posture. Use only adjustable chair or stool with built-in foot and arm rest.
- Avoid contact pressure (forearm and wrists contact with sharp edges). Apply foam padding to the front sharp edge of the fumehood/BSC to reduce pressure concentration.
- If you perform work in a fumehood or BSC while standing for prolonged periods of time, use an anti-fatigue mat and footrest to reduce muscle, joint, and spinal fatigue.
- Take short breaks to alter repetitive forearm and wrist motion, relieve joint pressure and contact pressure caused by sharp edges.
- Reduce eye strain and awkward posture by keeping viewing window of hood/BSC clean, and line of sight unobstructed.
- Make sure hood/BSC lighting is working properly, good and proper lighting help reduces eye strain.
- Raise cabinet couple inches upwards to create a more comfortable leg and thigh clearance.
- Purchase only ergonomically designed equipment and furniture.

Microscopy

Operating a microscope for long hours puts much strain on the neck, shoulders, eyes, lower back, and arms/wrists.

Associated Risk Factors:

- Awkward and static posture of the lower back
- Lack of adequate leg and knee clearance under work table
- Working with elbows winged
- Pinch grip when adjusting binocular eyepiece
- Wrist and palm contact pressure in the carpal tunnel area
- High repetition
- Eye strain and fatigue
- Awkward and static posture of the neck and head



Preventive Measures:

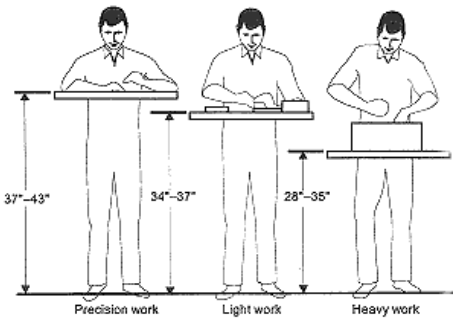
- Do not work with elbows winged. Keep elbows close to sides, below 45-degree angle.
- Make sure to work with wrists in neutral (straight) position. Avoid forearm and wrist contact pressure. Pad sharp edges with foam, or pad wrists and forearms to reduce pressure.
- Make sure leg and knee clearance under work bench is adequate.
- Always assume proper sitting position, Ensure proper lower back and thigh support.
- Ensure that feet are flat on floor or supported by footrest.
- Use only adjustable chair or stool with built-in foot and forearm rest.
- Avoid raising shoulders and bending neck while looking through microscope's eyepiece.
- Adjust microscope eyepiece's height to allow head and neck proper (upright) neutral posture.
- Position microscope as close as possible towards you to ensure upright head position.

- Use or purchase extended eyetube and/or variable height adapter to achieve proper neck and head position.
- Prevent repetition, and alter prolonged awkward posture. Take adequate small breaks, or perform other job tasks that require less repetition, rest your eyes, neck, and shoulders.
- Use video display terminal when appropriate to view sample, and reduce eye and neck strain.
- Make sure scopes remain clean all the time, and lighting is of proper intensity.

Laboratory Workbenches

When used inappropriately, laboratory workbenches can expose researchers to a variety of hazardous conditions or ergonomic risk factors depending on the laboratory procedure being used. Most workbenches at the University are of fixed heights and cannot be modified (raised or lowered). In general they are the same height and were designed for light to slightly heavy work. Using a laboratory workbench as a computer workstation is an example of inappropriate use, since it forces the worker to assume a variety of awkward postures and may increase the likelihood of acquiring MSD.

- If workbench height is above elbow height, between 37 and 43 inches, use for precision work.
- If workbench height is just below elbow height, between 34 and 37 inches, use for light work.
- If workbench height is below elbow, between 28 and 35 inches, use for heavy work.



Preventive Measures:

- Always assume proper sitting or standing neutral posture.
- When sitting, use only adjustable stool or chair with built-in foot and armrest to insure lower back, thigh, and feet support.
- If leg clearance is not available, workbench must not be used for work requiring using a stool. Otherwise, create legroom under the bench by removing drawers.
- When standing for extended periods of time, use anti-fatigue mats and a footrest to reduce joint strain and muscle fatigue.
- Remove drawers, supplies and other materials underneath workbenches to provide legroom.
- Take frequent small breaks to alter repetition, body awkward posture, and muscle static work.

References:

University of Minnesota DEHS website

JST Internal Lab Audits Standard Operating Procedure

PPE and Audit Committee

PURPOSE: The purpose of this document is to establish a working procedure for carrying out bi-annual lab safety audits in the Department of Chemistry (CHEM) and Department of Chemical Engineering and Materials Science (CEMS) at the University of Minnesota. These internal audits will be used to help labs improve safety conditions for researchers, increase inter-lab awareness of issues and incidents, and to assist in bringing all labs up to compliance with OSHA and DEHS standards. The ultimate goal is to support the larger JST mission of establishing a sustainable culture of excellent laboratory safety standards that are followed by all researchers on a daily basis.

RELATIONSHIP BETWEEN DEPARTMENTAL SAFETY TEAMS AND THE JST:

- The CEMS Safety Team would work with the JST Audits Committee in a supportive role, similar to the CHEM Safety Team, to improve awareness of safety issues through lab inspection
- The CEMS and CHEM Safety Teams (internal to each department and composed of faculty and JST Executive Committee members) would be the enforcement agency for improvements that need to be made that were found during JST lab audits

TIMEFRAME FOR IMPLEMENTATION:

- For 2012, a mass round of audits will be conducted from September through December
- For each year thereafter, audits would be done on a rolling basis throughout the year. The inspections would be scheduled collectively by the JST Audit Committee, would be random in order, and would be confidential to the Committee. Each PI will have their lab space audited twice annually, but the time between audits will be random

THE AUDITING GROUP:

- Each lab LSO will submit a response to a mandatory Google Docs form indicating the areas of research (solid state, organic chemistry, bio, etc.) that their lab works with. This form will be sent out for replies after the JST Kickoff Event on September 24, then annually in January thereafter
- All internal lab audits would be done by a group of three LSOs. Two will be selected from those whose research experience matches that of the labs being audited (common-area members), and one will be from outside the research area (outside-area member).
- One of the common-area members, who is also a member of the JST with prior auditing experience, will be designated the Audit Leader by the JST Auditing Committee.
- By participation numbers, each LSO would do 3 lab audits, twice per year. This will be considered a service obligation of all Chemistry and CEMS LSOs. Time commitment from LSOs is expected to be 3-5 hours annually
- Following the first round of audits, LSOs will be put into a rotation where they serve as the Audit Leader, a common-area member, and an outside-area member in subsequent audits

PRE-AUDIT:

- The auditing group would be notified via email from the JST Auditing Committee that they need to conduct an audit of the assigned three labs within a two week audit period. This notification will sent out two weeks prior to the start of the audit period
- The group is responsible for finding a compatible time between the members to conduct the audits by the end of the audit period
- The auditing group will notify the lab PIs and LSOs 24 hours in advance that a group of JST LSOs will be inspecting their lab at the designated time
- The group will meet outside the designated lab (with safety glasses and lab coats) 10 minutes before inspection starts for a pre-audit briefing by the Audit Leader
- If an audit group member cannot make an audit date, he or she will be personally required to find a replacement LSO to conduct the audit for him or her

AUDIT:

- Lab inspections should last no more than 45 minutes
- Audits are based on an exemplary/good/needs attention rating scale, done by standardized checklist completed by each inspector individually, with notes for why items were listed as "needs attention"
- The items on this checklist are TBD, but will be adapted from checklists already developed by DEHS and at Dow
- The audit group will take pictures of all “needs attention” items for thorough documentation

POST-AUDIT

- After comparing lists and discussing, an official Audit Report for submission will be prepared. This report would be prepared from a template by the Audit Leader and include:
    - A standardized cover letter that includes an invitation to the PI to have a meeting with the Audit Group to discuss the Report and receive any suggestions on how to remedy the issue items
    - Compiled checklist from audit
    - Pictures and explanations documenting any “needs attention” items
    - A summary statement of the overall impression of the lab safety
    - Comparison to peer groups audited in the same period - above/at/below peer lab safety quality
    - Total estimated cost of inspection failures if Hennepin County inspectors were to find the offenses, for appropriate items
    - A Notice, if appropriate, that they will be re-inspected for "needs attention" items in one/two weeks by a member of the CEMS or CHEM Safety Team, along with the date range for that inspection
- The compiled report is delivered to the lab PI and LSO via standardized email and departmental mail on letterhead
- The PI would be required to submit confirmation in writing to the audit group that they have received the Audit Report
- The compiled report, along with PI receipt of confirmation, is emailed to the JST Audit Committee by the end of the audit period
- Enforcement of further or repeat failures can be dealt with via discussion within the departmental Safety Teams
- The JST Audit Committee will maintain a secure, private database for the previous 2 years of Audit Reports, as well as the schedule of planned upcoming audits and a record of completed audits.

WALK-THROUGH EXAMPLE OF THE AUDIT PROCESS

The Buhlman, Bowser, and Arriaga labs in Chemistry need to be audited. Each of these labs performs research with some biohazards. Katie Hurley from the Haynes group is chosen as a team captain because she is (1) not from the labs being audited, (2) experienced with auditing through a Dow site visit, and (3) a member of a group that also performs biological research. The other team members are Kathryn Johnson (who has biological expertise) and Kate McGarry (an organic chemist without specific biological expertise).

The team members are notified by the Audit committee on Monday, September 3rd that they need to audit the Buhlman, Bowser, and Arriaga labs between September 17th and October 1st and submit their summary report to the Audit committee by October 1st (4 weeks after notification). Once they arrange an appropriate schedule, they send emails to the PIs and LSOs of the labs to be audited, 24 hours before they arrive. When they finish the audit, the team sits down to discuss and compile their findings, and then sends the Audit Report to the Audit Committee, and PI and LSO of the labs which were audited. The next time these three labs are audited (in about 6 months), the new audit team looks over the most recent report and pays attention to the improvement (or lack thereof) seen during their walkthrough.

EXPLANATION OF RATINGS SYSTEM:

Exemplary – This level of housekeeping and safety is very good and should be used as an example for other labs.

Acceptable – Most safety issues are being addressed adequately, although there is still room for improvement. This category could include some minor safety violations.

Needs Attention – The housekeeping or safety practices in this area are not acceptable and should be addressed promptly. The appropriate CHEM/CEMS safety team should be contacted for a follow-up audit of this specific area.

JST Internal Lab Audit Checklist

Principle Investigator: _____ JST Auditor: _____

Room(s): _____ Date: _____

Safety Item	Exemplary	Acceptable	Needs Attention	Comments
Researchers wearing correct PPE				
No food or drink in lab				
Aisles and hallways clear of chemicals and clutter				
Electronics near possible leakage sources raised off floor				
Hood sashes low				
Proper lab signage (emergency contacts, PPE requirements)				
Samples and chemicals in secondary containment				
Samples and chemicals segregated by hazard				
Samples and chemicals labeled (name, date, hazards)				
Samples and chemicals stored below eye level				
Waste labeled and capped				
Waste less than 90 days old				
SOPs available to group (Researchers know location – ask them!)				
Specialty hazards				

CEMS Emergency Contacts

Dial **911** if there is a fire or an emergency that requires an ambulance, police, firefighters, or building evacuation

Dial **911 and say "Call AHERPS"** in the event of a spill, leak, exposure or any other situation in which you require immediate help from DEHS

When you call **911 then say "Call AHERPS"** you must report:

1. Emergency information
    a) Building, Room or Location
    b) Caller's name, location and phone
    c) Type of emergency
    d) Is there a fire, explosion or is anyone injured?
    e) Name and amount of material released
2. You may be asked to:
    a) Restrict traffic and personnel into area if it is safe to do so
    b) Remain available for follow-up
    c) Hold all personnel who are in the area at the time of the occurrence, in a safe location

If you have a question or concern for DEHS that *does not require their immediate response*, call the DEHS front office 612-626-6002 or contact Anna (engl0131@umn.edu, 612 625-8925).

Front Office, CEMS 612-625-1313

Poison Control 1-800-222-1222

U of MN Emergency Management 612-625-8047

Utility and Facility problems, Building Systems Automation Center (BSAC) 612-625-0011

CareLine 24-Hour, U of MN Health Partners 612-339-3663
staffed with registered nurses who can counsel employees on where to seek care in the event of an exposure

Office of Occupational Health and Safety 612-626-5008

Other Numbers:

Hazardous Waste, DEHS (NON-Emergency) 612-624-8855

Anna Englund, Research Safety Specialist for CHEM and CEMS (DEHS Staff) 612-625-8925

Raúl A. Caretta, Safety Officer 612-625-8066

_____Principle Investigator ..... _____

_____Lab Safety Officer ..... _____

CHEM Emergency Contacts

Dial **911** if there is a fire or an emergency that requires an ambulance, police, firefighters, or building evacuation

Dial **911 and say "Call AHERPS"** in the event of a spill, leak, exposure or any other situation in which you require immediate help from DEHS

When you call **911 then say "Call AHERPS"** you must report:

1. Emergency information
    a) Building, Room or Location
    b) Caller's name, location and phone
    c) Type of emergency
    d) Is there a fire, explosion or is anyone injured?
    e) Name and amount of material released
2. You may be asked to:
    a) Restrict traffic and personnel into area if it is safe to do so
    b) Remain available for follow-up
    c) Hold all personnel who are in the area at the time of the occurrence, in a safe location

If you have a question or concern for DEHS that *does not require their immediate response*, call the DEHS front office 612-626-6002 or contact Anna (engl0131@umn.edu, 612 625-8925).

Front Office, CHEM 612-624-6000

Poison Control 1-800-222-1222

U of MN Emergency Management 612-625-8047

Utility and Facility problems, Building Systems Automation Center (BSAC) 612-625-0011

CareLine 24-Hour, U of MN Health Partners 612-339-3663
staffed with registered nurses who can counsel employees on where to seek care in the event of an exposure

Office of Occupational Health and Safety 612-626-5008

Other Numbers:

Hazardous Waste, DEHS (NON-Emergency) 612-624-8855

Anna Englund, Research Safety Specialist for CHEM and CEMS (DEHS Staff) 612-625-8925

Chuck Tomlinson, Director of Operations (CHEM Front Office Staff) 612-624-2321

Ted Tolaas, Safety Team 612-624-5585

Andreas Stein, Safety Team 612-625-1802

_____Principle Investigator ..... _____

_____Lab Safety Officer ..... _____

CEMS Emergency Procedures

Chemical Spills:

If you are unsure of whether you have a small, moderate, or large spill, contact DEHS (**911** then say **"Call AHERPS"**) immediately.

- *Small spill* - spills that do not pose an immediate hazard, clean up manageable by researcher
- *Moderate spill* - spills that pose an immediate hazard or clean up too much for researcher, clean up manageable by DEHS
- *Large spill* - spills that pose immediate hazard which require immediate building evacuation

Small Spills:

Lab personnel can clean up relatively small, manageable spills (Hazards must be taken into consideration FIRST) that do not pose an immediate hazard if it does not put them or anyone else in danger.

1. Do NOT use spill kits for HF, radioactive material, or mercury spills
2. Use a spill kit if one is readily available in lab. Otherwise, follow procedures for moderate or large spills.
3. Notify Raul Caretta **as soon as possible:** 5-8066

Moderate to Large Spills:

For any spill that presents an immediate hazard (fire, explosion, chemical exposure, etc.) or is a highly dangerous chemical

1. Evacuate the area and alert others in the area
2. Remove victims to fresh air
    - Remove contaminated clothing and flush contaminated skin and eyes with water for 15 minutes.
    - If anyone has been injured or exposed to toxic chemicals/vapors **call 911** and seek medical attention immediately.
3. Confine: close doors and isolate the area
4. Contact emergency personnel
    - Call **911** and say "**Call AHERPS"**, then you must report:
        1. Emergency information
            a) Building, Room or Location
            b) Caller's name, location and phone
            c) Type of emergency
            d) Is there a fire, explosion or is anyone injured?
            e) Name and amount of material released
        2. You may be asked to:
            a) Restrict traffic and personnel into area if it is safe to do so
            b) Remain available for follow-up
            c) Hold all personnel who are in the area at the time of the occurrence, in a safe location
5. Contact the **Front Office as soon as possible: 5-1313**

Fire or Release of Toxic or Explosive Material:

1. If you are trained and the fire size is manageable, use fire extinguisher to put out fire.
2. If unmanageable fire, remove all personnel from area.
3. Close off area to prevent spread of hazardous material or fire.
4. **Call 911** to report the nature and location of the hazard.
5. Activate the building alarm system at the nearest manual alarm station
6. In *all* cases, report the incident to the **Front Office: 5-1313**

Injury:

1. If minor, go to the U of M Hospital Emergency Room **accompanied by another person**.
   If the injury is serious dial **911** and describe your injury as well as your location.
2. Notify Raul Caretta: **5-8066**
3. A First Report of Injury **must** be filled out promptly

CHEM Emergency Procedures

Chemical Spills:

If you are unsure of whether you have a small, moderate, or large spill, contact DEHS (**911** then say **"Call AHERPS"**) immediately.

- *Small spill* - spills that do not pose an immediate hazard, clean up manageable by researcher
- *Moderate spill* - spills that pose an immediate hazard or clean up too much for researcher, clean up manageable by DEHS
- *Large spill* - spills that pose immediate hazard which require immediate building evacuation

Small Spills:

Lab personnel can clean up relatively small, manageable spills (Hazards must be taken into consideration FIRST) that do not pose an immediate hazard if it does not put them or anyone else in danger.

4. Do NOT use spill kits for HF, radioactive material, or mercury spills
5. Spill kits are located in
   Kolthoff - the northwest hallway near 681
   Smith - the hallway by the east elevator on the sub-basement level
6. Notify Chuck Tomlinson **as soon as possible:** 4-2321

Moderate to Large Spills:

For any spill that presents an immediate hazard (fire, explosion, chemical exposure, etc.) or is a highly dangerous chemical

6. Evacuate the area and alert others in the area
7. Remove victims to fresh air
   - Remove contaminated clothing and flush contaminated skin and eyes with water for 15 minutes.
   - If anyone has been injured or exposed to toxic chemicals/vapors **call 911** and seek medical attention immediately.
8. Confine: close doors and isolate the area
9. Contact emergency personnel
   - Call **911** and say "**Call AHERPS"**, then you must report:
     1. Emergency information
        f) Building, Room or Location
        g) Caller's name, location and phone
        h) Type of emergency
        i) Is there a fire, explosion or is anyone injured?
        j) Name and amount of material released
     2. You may be asked to:
        d) Restrict traffic and personnel into area if it is safe to do so
        e) Remain available for follow-up
        f) Hold all personnel who are in the area at the time of the occurrence, in a safe location
10. Contact the **Front Office as soon as possible: 4-6000**

Fire or Release of Toxic or Explosive Material:

1. If you are trained and the fire size is manageable, use fire extinguisher to put out fire.
2. If unmanageable fire, remove all personnel from area.
3. Close off area to prevent spread of hazardous material or fire.
4. **Call 911** to report the nature and location of the hazard.
5. Activate the building alarm system at the nearest manual alarm station
6. In *all* cases, report the incident to the **Front Office: 5-1313**

Injury:

1. If minor, go to the U of M Hospital Emergency Room **accompanied by another person**.
   If the injury is serious dial **911** and describe your injury as well as your location.
2. Notify Raul Caretta: **5-8066**
3. A First Report of Injury **must** be filled out promptly

Eyewash Inspection

Weekly Checklist

Recommended 3 min weekly flush and 15 min monthly flush (to ensure continuous water flow and inhibit growth of bacteria)

Check that:

- area around the eyewash station is clear of obstruction, debris or tripping hazards
- eyewash station operates correctly:
  - activating arm operates smoothly and remains open when released
  - water flows continuously, with each nozzle expelling water in roughly equal amounts and equal height
  - water is clear and colorless

Date	Initials

Date	Initials

Date	Initials

Post this checklist next to each eyewash station and keep as a record for 1 year.
Indicate the weeks with a check mark in which a 15 min monthly flush was performed.

Laboratory Information	Building & Room	
	Principal Investigator, phone/email	
	Lab Safety Officer, phone/email	
	Description	
Minimum PPE Required		
Hazards	In an emergency, call 911. In non-emergency situations, contact the LSO or PI.	

Resources

Chemical Hygiene Plans:

- Department of Chemistry
  http://www.chem.umn.edu/services/safety/ChemHygPlan.html
- Department of Chemical Engineering and Materials Science
  http://www.cems.umn.edu/about/safety/cems_hyg_plan.pdf

JST Website:

http://www.jst.umn.edu

DEHS Links:

- Homepage
  http://www.dehs.umn.edu/
- Hazardous Waste Management Guidebook
  http://www.dehs.umn.edu/hazwaste_chemwaste_umn_cwmgbk.htm
- Online Training
  http://www.dehs.umn.edu/training.htm
- Research Safety Plan
  http://www.dehs.umn.edu/ressafety_rsp.htm

Sigma-Aldrich Technical Bulletins:

http://www.sigmaaldrich.com/chemistry/chemical-synthesis/learning-center/technical-bulletins.html

ACS Links:

- Chemical Safety Practices & Recommendations
  http://portal.acs.org/portal/acs/corg/content?_nfpb=true&_pageLabel=PP_SUPERARTICLE&node_id=2231&use_sec=false&sec_url_var=region1&__uuid=d4c89dc0-c1ce-4cb1-a27d-df865ac16dd1
- The Safety Zone Blog
  http://cenblog.org/the-safety-zone/

UCLA's SOP Library List:

http://www.sop.ehs.ucla.edu/